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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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TO THE MEMBERS OF THE AMERICAN GAS-LIGHT ASSOCIATION.

OFFICE OF THE AMERICAN GAS-LIGHT ASSOCIATION,

117 BROADWAY, NEW YORK, Aug. 31, 1876.

The Fourth Annual Meeting of the AMERICAN GAS-LIGHT ASSOCIATION will be held at CHICKERING HALL cor. 5th Avenue and 18th st., New York City, on the 18th and 19th of Oct., at 10 o'clock, A. M.

Headquarters will be at the Hoffman House, Broadway and 25th street.

Arrangements have been made for special cars to Philadelphia in case a sufficient number of members desire to visit the Exhibition after the adjournment.

CHAS. NETTLETON, SECY.

THE FOURTH ANNUAL MEETING OF THE AMERICAN GAS-LIGHT ASSOCIATION.

It is hardly necessary, at this late day, to remind any of the importance of making this meeting a success in quality as well as quantity. It is to be sincerely hoped that none will stand back to see what the others will do, but that every man will be in his place, prepared to do his own share towards establishing a high character for this Association.

A NEW COAL AGENCY.

A new general agency for the sale and delivery of the coals on the line of the Chesapeake and Ohio Railroad, has just been established in this city, with Mr. A. S. Hatch as general manager. This is a true *Reform* in the business management of the marketing of these coals. It is a well known fact, that coals of a most excellent quality are found in great variety and abundance in the Kanawha and New River Regions. But heretofore the efforts made to introduce them have been divided, and often uncertain in results. Some of the larger companies, such as the Cannelton and Peytona, have by the care and attention paid to the screening, handling, shipping, etc. of their products, made a steady advance in popular favor, independent of their acknowledged high quality. With some of the other coals from this region, the want of uniformity in the manner of handling, and in the condition in which they have sometimes been sent to this market, has perhaps worked to their disadvantage, in not securing for them the full recognition of their excellence. The object of the new agency is not to interefere with existing arrangements of miners, for the sale of their coals through their own agents, except so far as they may prefer to avail themselves of its facilities, but to assist them in extending their business.

This general agency has no interest in either mines or coal properties for sale, but is designed to act strictly as joint agent for the railroad company and all miners, whereby uniform and just rates shall be secured to all in the matter of transportation and also to secure the delivery of coal in its best condition to the consumer. Reliable and disinterested information can at all times be obtained of Mr. Hatch as to any of these coals, either for gas, steam, or other purposes. The best known caking coals from this region are the Blacksburg, Coal Valley and Cannelton, together with the "Straughn" and the Utopia. And it is proposed to use every proper effort to secure the more general introduction and use of these, and such other as may be developed hereafter.

Cheap coals are of vital importance to every gas company, and anything which tends towards the developement of new coal fields, if the quality of their product is up to standard, must contribute to the desired end, for as the source of supply is extended the less liability there will be to combination, and a healthy competition can be maintained, wherein each producer must rely upon the price and quality of his coal to secure its sale.

NAPHTHA.

In a very courteous letter received from a correspondent in Pittsburgh, for whose opinion in the matter referred to we have the highest respect, we find the following relating to our article of October 2nd, on the price of Petroleum.

"You do not directly assert, but your words plainly imply, that the cost of the petroleum used by gas makers has increased, and your quotation from the *Iron Age* strengthens the inference. If crude petroleum were in common use in gas making, your statement would be correct; but it is not."

The letter then proceeds to say that where any petroleum is used it is usually *naphtha* or *benzine*, and that, from the writer's point of view—"the extreme fluctuations for two years last past, in price of naphtha, have not been twenty per cent., while the average fluctuations, from month to month, have not exceeded two per cent."

In the article referred to we were guided by prices

as quoted in New York by the daily papers, and by references thereto we find, on July 18th, 1876, "naphtha, 10½c." On Sept. 28th, "naphtha, 14c." This would indicate a fluctuation of nearly 40 per cent. in two months; and, furthermore, we cannot see why there should not be some relation between the price of crude and naphtha, or why, if crude goes up, naphtha should go down.

Obituary.

SANUEL DOWN.

We regret that it is our duty to announce to the gas fraternity the death of Mr. Samuel Down, President of the American Meter Company.

Few men living have been longer or more intimately identified with the gas interest in this country than Mr. Down. His labors to promote it have been long, persevering, and successful, and there are to-day many companies in whose works some specimen of his ingenious handiwork stands as a monument to perpetuate the testimony of his mechanical skill and integrity. As to the many other characteristics of his nature, the following, from one who knew him long and well, is far better testimony than that of one personally unknown to him. In his death not only the corporation of which he was the President, but the gas fraternity at large have met with a loss that will be deeply felt.

In the death of Samuel Down the gas-light interest of the country has lost one of its noblest representatives.

He was a high-toned and most honorable man. It was impossible to know him intimately and not to love him.

Many years ago, when the writer of this was the junior clerk of the Manhattan Gas Light Company, Samuel Down was a journeyman mechanic in the workshop of that company. He was then remarkable as a man of untiring industry, and of great skill and judgment in the particular branch in which he was engaged. At that time all the gas meters in this country were imported from England. Mr. Code, of London, was employed by this company to repair the meters for a while, when he joined with Mr. Colton, of Philadelphia, and established the house of Colton and Code, which soon became a strong and highly prosperous establishment.

Mr. Down then succeeded Mr. Code in the meter department of the Manhattan Gas Light Company, and commenced the manufacture of meters on his own account.

He was highly successful. His sterling integrity, his superior skill, and his amiable disposition soon won the confidence and regard of the officers of gas companies throughout the United States, Canada, and the West Indies. He afterwards united with the Philadelphia House, which had undergone several changes caused by the death and the voluntary retirement of the members of the firm there, and established the "American Meter Company," of which company he was elected President, retaining that office until the day of his death. Of that company it is unnecessary to speak. Its reputation is world wide. It not only put a stop to the importation of gas meters from Europe, but engaged in the manufacture of the most delicate apparatus required in the laboratory, and which has become a necessity to every well-educated gas engineer.

In all the improvements which have taken place in this branch of our profession, the clear head and careful observations of Samuel Down can be distinctly traced. He will be remembered and honored as a mechanic of superior skill and judgment.

As a man and a friend he won the love of many. He was charitable in the extreme.

Many a kind and generous act he did of which the world will have no knowledge. Some of these I was compelled to know, to enable him to accomplish the objects he had in view, and which he charged me never to repeat; but now he has passed away, I cannot but bear testimony to the character of one of the noblest and kindest men I have ever known.

May his memory be cherished; may his example stimulate others to do good, trusting to that reward which awaits the just and true.

CHARLES ROOME.

On the Failure of the Worcester Dam.

A REPORT BY THEODORE G. ELLIS, C. E., DAVID M. GREENE, C. E., AND WILLIAM W. WILSON, C. E., MEMBERS OF THIS SOCIETY.

[Presented June 15th, 1876.]

To the American Society of Civil Engineers:

Your committee, to whom was intrusted the matter of an examination and report upon the causes of the failure of the Lynde Brook Dam, at Worcester, Massachusetts, begs leave to report:

That they visited the scene of the late disaster on May 16th, about seven weeks after the failure of the dam, and made a thorough examination of the evidences yet remaining of the causes of the original leakage and subsequent giving way of the structure; together with what could be observed of the materials used and the general construction of the work. Before visiting the locality, it was supposed that it was rather a late day to examine evidences of the failure. But the examination made at the above named date shows that the removal of the debris and the excavations that have been made in the bed of the stream, exhibit some points of interest that could not otherwise have been observed. Numbers of excellent photographs were taken soon after the accident, and part of your committee had visited the dam immediately after its destruction.

On arrival at Worcester, your committee visited Mr. Blake, the city engineer, with a view to examining the plans upon which the dam was constructed; but in consequence of instructions from higher authority, he did not feel permitted to show them. Your committee therefore was obliged to procure the information desired from other sources.

The Lynde Brook reservoir lies in the town of Leicester, about 4 miles west of the city of Worcester, and 1½ miles north of the track of the Boston & Albany R. R. The main part of the dam runs nearly east, across the bed of the stream, which flows to the south. This part of the dam is about 600 or 700 feet long. The east end curves to the north and extends about 1,000 feet across a low divide, to prevent the water from wasting in that direction. This dam was built in 1870 and 1871. The pond was of about 132 acres in area, and contained when full, 663,330,000 gallons.

The failure occurred in the main body of the dam, in the bed of the brook, in the line of the gate houses and where the supply pipes passed through the embankment.

This main dam consisted of an earth embankment, composed of an excellent material, brought up in layers of about six inches, and thoroughly worked together. In the centre was a wall, built chiefly of cobblestones laid in hydraulic cement. It was intended to be 3 feet thick, but the part remaining measures about 33 inches. This wall was constructed by building up the outside a short distance, and filling the interior with concrete. The cement used was of good quality, and the work was tolerably well done, although such a wall is far from being water-tight. In the bed of the brook, through the dam, was an arched culvert for containing the supply-pipes, 8 feet wide and 8 feet high in the clear. The side walls were 5 feet thick, and extended 2 feet below the top of the paving. The arch was 18 inches thick, and was covered on top with a layer of cement and brick. The paving consisted of 8 inch cubes of granite, under which were flag-stones lying upon about 10 inches of broken stone. The side walls, arch and granite blocks were all laid in hydraulic cement of good quality; the side walls being built double and filled in with concrete.

At the upper end of this culvert was the main gate house, a very substantial structure of stone, lined with brick, extending from the foundation of the dam to the top, with a chamber above that level which was roofed and furnished with doors and windows. At the lower end of the arched culvert there was another gate house, of small size, one story high, provided with a door and windows, containing the waste gates. From this gate-house a round stone culvert reached some distance into the stream below, to carry off the waste water. The floor of the gate-house was paved with 8 inch cubes like the arch, but resting on the natural earth. These gate-houses were situated somewhat inside of the foot of the slopes and wing-walls were built of dry rubble to hold the foot of the slope.

The top of the embankment was about 50 feet wide, with a slope of 2 to 1 on the upper side, and a slope of 2½ to one on the lower side. Its height at the gate-house was 41 feet, being four feet above the sill of the waste-way. The arched culvert pierced the central wall which was built up to it on all sides. Between the upper gate-house and the culvert was a strong bulkhead of masonry, about ten feet thick, laid in cement, through which passed the two 24 inch supply-pipes. This bulkhead does not seem to have extended in any direction beyond the gate-house.

At the west end of the dam was a waste-way, 22 feet wide, which extended along the side hill to some distance below the end of the lower slope. This waste-way had one side wall on the down hill side laid in cement, and a concave bottom of rough stone paving, laid dry, about 2 feet thick. Over the central wall, a cut granite sill was laid, close up to which came the dry paving on the upper side. This paving was a continuation of the rough stone facing, of about 18 inches thick, covering the upper slope of the dam. Before the construction of the dam which failed, there was a dam at this place of less height, which was covered up by the new dam when built. This old dam had a central wall of masonry, similar to that above described, except that it was thinner and was built in a single wall which now shows in the sides of the excavation. The middle portion of the old dam was removed in digging the foundations for the masonry of the new dam. The part now washed out shows that the sod was not removed from under the old dam, but was removed in the new construction. Particular inquiries were made regarding the foundations of the masonry of the arched culvert and gate-house where the failure took place, and it was ascertained that after the arch was built and it was desired to put in the paving, it was found that it could not be done as intended, on account of the softness of the bottom. At the upper end of the arch, the ground could be shaken by stepping upon it, and it was wet and springy.

The way in which the paving was laid, was by pressing into the ground the rough stones before mentioned and then covering them with the flag

stones, upon which the granite blocks were laid in cement. A like difficulty seems to have been experienced with the foundation of the upper gate-house. Here it was necessary to press into the moist and springy earth, about 3 feet in thickness of broken stone, before the masonry in cement could be commenced. This gate-house does not appear to have settled previous to the giving away of the dam.

It is stated in the newspaper accounts of the disaster, that there has been a leakage into the culvert ever since the dam was completed. The commencement of the failure was about two years ago, when water was first observed leaking in considerable quantities into the pipe culvert, about 20 feet above the central wall, and passing out through the arch and lower gate-house. In April, 1875, the leakage was at the rate of 24 221 gallons in twenty-four hours, with the water 6 feet below the waste-way. In July, under a similar head, it had increased to 39 810 gallons per day. On September 7th, 1875, the city engineer called attention to the increased leakage, and recommended "that the pipe arch be thoroughly cleaned of all deposit, which will enable careful inspection to determine, if the water is discolored on entering the archway, which would indicate an increase of wash under the foundation." Under date of December 1st, 1875, he reported that the clearing out of the deposit had been done, and that a wier had been placed in the pipe culvert itself, where only the water entering through the leak could be measured. Previous to this time the only means of measuring the leakage had been by a wier below the outlet of the waste culvert, which was defective and unreliable at times from the effect of surface water. On this date, the engineer reports, "the leakage at present is 48 448 gallons per day, showing an increase of about 24 000 gallons since April 1st, It being important to locate the leakage, two weirs were set in the arch, one a short distance from the upper end, and the other near the lower end. It is a matter of congratulation that the investigations prove the leakage is confined entirely within a short distance of the upper end." During the year ending December 1st, 1875, the reservoir was not at any time full, the height of water being from 3½ to 19½ feet below the level of the waste-way.

In the above-named state of affairs, in the opinion of your committee, it was only a question of time when the dam should be destroyed, and it seems to be somewhat remarkable that this should not have been appreciated by those having charge of it, and immediate steps taken to repair the damage and stop the leak. Nothing, however, appears to have been done, and when the reservoir filled up in the spring of 1876, the leak largely increased. Two days before the final giving way of the embankment, large quantities of muddy water were observed to be flowing from the waste culvert below the lower gate-house. An examination was made, and the water was found to be entering at or near the place of the old leak. The flow rapidly increased, until just before the final catastrophe, the water rose in the lower gate-house so as to flow from the door and windows, being more than the waste culvert could discharge.

The first caving in of the embankment took place on the west side of the upper gate-house, after which it went rapidly, the central wall checked the rush of water for an instant, and then the whole gave way before the vast volume pouring from the reservoir above. The upper gate-house fell over to the southwest, against the sloping side of the chasm and mostly broke up though some portions of the masonry remained together.

In the opinion of your committee there is no doubt as to what was the immediate cause of the failure of this dam. There was evidently a stratum of porous material lying under the upper gate-house and the upper end of the pipe vault, partaking of the nature of a quicksand, which should have been removed, and greater precautions taken to prevent the access of water from the reservoir, than appears to have been the case in the foundations before described. The water found its way through the porous bed on which the gate-house and arch foundations rested, and leaked through the interstices of the masonry of the vault until it wore a passage large enough to carry the earth with it, after which the destruction proceeded with great rapidity.

[To be continued.]

Municipal Works of Brnssels.

[Translated from "Le Gaz," for Am. Gas-Light Journal.]

Upon the 7th of August last a number of the members of the Association of Engineers, graduates of the school at Liege, together with some other distinguished persons, visited the gas works of the City of Brussels.

Mr. L. Somzee, the engineer of the works, received the guests, and conducted them through the entire works, explaining to them all the special details.

The construction of the buildings, the benches, the scrubbers, the condensers, the purifiers, and the holders is such that each and every part of the works can be doubled without any change in the original structures, and this provision is all the more valuable from the fact that the time is not distant when Brussels will have a population of 500,000, and that still further increase may be expected in the immediate future. True wisdom is shown in foreseeing this increase of population and providing for it.

It was regretted that the works in progress in the meter house were not sufficiently advanced to enable the three station meters of a capacity of 50,000 cubic meters each to be seen in their completed state; but the various parts not yet in position were seen, and the workmanship much admired. The circular envelopes of the meters were already in place.

After going through all of the works there remained only the holder to be visited. This is of a capacity of 22,000 cubic meters, and it having been announced that a lunch was to be served, and no signs of any preparation therefor having been detected in any part of the works, those present were beginning to think that disappointment awaited them in this respect; but, after examining the exterior, the party were invited to descend through the manhole covers to examine the interior. Upon descending to the bottom of the tank they found the air refreshed by a fountain playing in the centre, surrounded by plants and flowers. Around this was arranged a circular table, where the 250 people composing the party sat down to a most sumptuous banquet served in the most perfect manner. The desert being finished, toasts were offered and heartily responded to.

Mr. Trasenster, President of the Association of Engineers, proposed at the close of a very happy speech, the health of Mr. Somzee, to which Mr. Somzee replied in a modest speech, thanking his guests for the kind expressions they had seen fit to use concerning him, and proposed the health of the Burgomaster, the College of the city of Brussels, the Commission on Gas, and the Prosperity of their Association, which was received with applause by all present.

The collation being over the party departed enchanted with their very cordial reception.

The Association of Engineers has published in one volume all the details observed in their visit to the gas works of Laeken; it is illustrated with plates showing the disposition and arrangement of the principal apparatus. We give some extracts from this book—

The creation of a gas works for lighting the city of Brussels was decided upon by the Council of the Commune on the the 3d of August, 1874. About the first of September Mr. Somzee was appointed engineer, and he made the plans and directed the work, and later, at the request of the city, he took the general direction of the service for lighting; and, upon the recommendation of Mr. Somzee, in the month of January last, Mr. Aerts was appointed manager of the works at Laeken. The city purchased a tract of land containing about eight hectares (twenty acres) situated on the canal. Mr. Somzee immediately applied himself to the work, and by the 20th of September the plans necessary to obtain the authority for construction, were submitted for the approbation of the provincial council.

In the course of the month of November following the works were put under contract and the first stone was laid on the 7th of December.

Under the energetic direction of Mr. Somzee, the benches were fired up on the 1st of August, 1875, and on the 25th of the same month the gas making commenced, and it was sent out for consumption. The number of working days employed in the construction of the works was 165, and thirty millions of brick and five million kilogrammes of iron, cast and wrought, have been used.

The constructions may be divided into four groupes, viz.:

1st. The retort houses and coal sheds.

2nd. The machinery, purifiers and station meters.

3rd. The holders.

4th. The work shops, store houses, and offices,

The construction of the buildings, benches, scrubbers, condensers, purifiers, and holders is such, that the extension of any one of these parts of the works may be duplicated without changing in any respect the original arrangement. The works are intended to make about 130,000 cubic meters of gas per day (24 hours), which would correspond to an annual production of 25,000,000 cubic meters.

The retort houses are four in number, containing in each two ranges of 16 benches, or one hundred and twenty-eight in all. Each range is composed of eight benches, arranged back to back.

Each group of benches has its hydraulic main of a length of 150 meters, the length of the walls of the building. These are 0.4 meter in diameter, and connect near the scrubbers with two pipes of 0.60 in diameter, which lead the gas to the "extractures."

The condensation is completed in the "scrubbers a cascades," which are of a special form. This apparatus is 2·5 meters in diameter and 11 meters high, and the lower part contains lentils in which the gas circulates in contact with water. The upper part is arranged with trays upon which coke or other material is placed. Water is showered upon the coke in each compartment.

The separation of the tar from the ammonia water is effected mechanically in the separators. Each group of benches is served by two scrubbers. One scrubber, six meters in diameter and 24 meters high, placed just before the engines completes the condensation. The operation is regulated by the results of the analyses of the gas made at the different stages of the manufacture.

The precipitation of naphthaline can be facilitated in this apparatus by means of a jet of steam.

The whole condensing surface, including the mains and scrubbers, is about 50 square meters for every 1,000 cubic meters of gas made in 24 hours-

Coal Houses.

These are four in number, alternating with the retort houses. Each one is arranged with railroad tracks, and will contain about 10,000 tons of coal. The coals now used have been furnished by five mines in Borinage, four mines in the basin of the Rhur, and two English mines. The coal carbonized this year amounts to about 100,000 tons.

[To be concluded.]

The Manufacture of Coal Illuminating Gas.*

By Alfred P. Trautwein, M. E.

Continued from page 157.

The subject seems interesting enough to warrant an examination of the English methods of setting the retorts. In Great Britain, as well as in Europe generally, it is common practice to use ovens containing seven retorts, and in works of any importance comparatively few exist in which less than that number are employed. It is quite common, on the contrary, to set the retorts eight or nine in one oven, and Mr. Methven has designed a setting of ten retorts. In the English benches of seven retorts, the average area of grate surface is from 30 to 40% smaller than that which our engineers are accustomed to allow for benches of six retorts. In England it is considered good practice to have one square foot of grate surface for every ton of coal carbonized, while with us 1·3—1·8 square feet are made to do the same amount of work. It would, therefore, appear that abroad less fuel is required to carbonize a ton of coal than with us.

The first glance at an English setting, however, will suffice to satisfy us that there large gas yields cannot but be considered as of secondary importance only; too much brickwork surrounds the retorts, while the consumption of fuel is surprisingly small. The European practice, on the other hand, though differing so widely from our own, is quite as well adapted to its purposes as is the American mode of setting the retorts to our requirements. The coal deposits of Europe consist essentially of bituminous coals; there is, however, one great drawback to their use as fuel—their tendency to produce smoke—and the prevention of this smoke has always been found to be a most difficult problem. Coke being free from this objection, its manufacture has there for hundreds of years been an important industry. In England, therefore, and in Europe generally, coke is not regarded as it is with us—a mere by-product in the manufacture of gas; and though gas coke is not considered to have the same calorific value as coke made in ovens, yet it there forms a revenue of almost, if not, the same importance as the gas itself. In the United States, on the other hand, this condition of things cannot exist; having such enormous anthracite coal fields, we are not generally compelled to use bituminous coal, and only in certain sections of the country is the use of coke as fuel very common. With us the high price of gas coals compels our managers to extract all the gas which with advantage can possibly be taken from the coal; this also explains why, in many parts of our country, gas cannot be as cheaply manufactured as in others, and more particularly abroad where the gas coal is fully paid for by the sale of the resultant coke.

Nothing has as yet been said of the elements which are involved in the successful construction and subsequent working of a retort-setting. Mr. E. S. Cathels, in his paper on "Retort Setting and Working," gives three conditions which have to be fulfilled to this effect—

First: "To so arrange the course of the furnace gases that heat will be imparted not only to all the retorts in the bed, but also to the whole length of each retort as nearly as possible along.

Second: "That the brickwork be so contrived as to give the required amount of support to the retorts at the greatest number of points, with as little actual covering of the retorts as possible, and without interfering with the free play of the furnace flame, and—

Third: "That the retorts be set sufficiently close to each other."

The reason which is given for the latter condition is, that since the resistance to the passage of the furnace gases is thus increased, they are more thoroughly deprived of their heat. It appears, however, that this precaution is superfluous, since the rapidity with which the gases pass through the bench can be adjusted to a nicety by means of the dampers. When the first two requirements are fulfilled, the consumption of coke as fuel need not be greater than 33 per cent. of the total coke made, or 12 bushels per ton of coal carbonized. It is true, instances may be found abroad in which but 20 or 25 per cent. of the coke was consumed, but the heats and consequent gas yields which were thus attained cannot compare with even our more common results.

The selection, for the projected works, of some system of setting the retorts is next in order; having become acquainted with the principles which will guide us in this matter, and bearing in mind what has previously been said on this subject, this final selection should not be a very difficult problem. We may thus discard, in the first place, several methods of setting retorts from the fact that almost the entire weight both of retorts and "saddle-tiles" is directly borne by the lower retorts, the injurious effects of which have previously been pointed out*; this limits our choice to one of two systems which are free from this objection.

The setting which was here adopted is similar to that which has been so successfully applied in the case of the Nassau Gas Works, Brooklyn, E. D., and at Providence, R. I., and which will presently be in use at the works of the Brooklyn Gas-Light Company. The writer has had peculiar opportunities of becoming acquainted with all the details of this setting, and in view of its obvious advantages, has not hesitated in in adopting it.† This setting is known as the Stanley setting.

The leading dimensions of the bench, as adopted for the projected works are as follows:

Interior width of the skeleton.....7 ft. 4 ins.
Depth of bench.....9 ft. 0 ins.
Height from grate to "skewback".6 ft. 8 ins.
Rise of circular arch.....2 ft. 0 ins.
Grate: length, 5 ft., width, 12 inches

The circular arch was adopted not only because of its naturally greater strength, but also of the fact that it is constructed more easily than the elliptical arch for which, in this case, no particular merit could be claimed. The benches are placed in two sections, back to back; the common division wall is 22½", the side party walls are 13", and the face wall is 13½" thick. It is generally customary to make the last two 14" and 9", respectively, but it is always well to make the walls as heavy as possible, not only for the purpose of intercepting radiation, but also to prevent the walls from cracking and bulging. For the same reason there are fully three feet of solid brickwork above the crown of the circular arch, while the end benches have 18" red brick walls in addition to the 18" of firebrick.

The floor line being given, it became necessary to place the lowest retorts at a sufficient height to allow the "buggies" to pass under the mouthpieces; the greatest height at which the upper retorts can be conveniently worked is about 5 feet 6 inches; having thus located the upper and lower retorts, the available space between the retorts is found to be 3¼". Now, most of our American fireclays expand considerably under the influence of heat, and to this observation is due this feature of our setting. When the retorts are fully set, and the bench ready for firing up, it will be seen that the retorts are supported at their ends only and, not as is usually the case, by means of a number of saddle-tiles at intermediate points. Although three such tiles exist under each of the retorts, yet a space of ¼" is left between each saddle-tile and the retort above it; bearing in mind, then, that the whole bed has a tendency to expand upwards, it becomes evident that, on first firing, the lower parts of the bench being hotter than the remainder, will expand more than will the upper portions; the ¼" space, therefore, is gradually reduced, and when the whole bed has attained a uniform temperature every retort and tile will be in its proper and final position. If this precaution is not taken, and the saddle-tiles are in position at first firing, there is always a liability of an undue strain being brought upon those parts of the retorts which are covered by them, and, it might be well to state, it has been observed that rupture usually occurs at these very points. This, it is true, may be partly accounted for by the fact that usually much of the weight of the upper retorts was borne by the lower retorts, through the agency of the saddle-tiles, which simply rested upon them; in this form of setting and, it is believed, in that in use at the New York Mutual Gas Works, this defect is removed by so arranging the saddle-tiles that their weight is taken off from the retorts and directly transferred to the floor of the bench. In our setting the center tiles or arches are omitted; they are not only superfluous but at the same time they obstruct the free passage of the furnace flame. As ordinarily arranged their only merit would seem to lie in the fact that they serve to distribute the weight of the retorts over a slightly larger area.

Beneath each of the lower retorts are two flues, 9" × 13", running the whole length; greater economy is thus secured, since the furnace gases are compelled twice to travel the entire length of the retort; the upward flues, two for each bench, are also 9" × 13", and are contained in the 22½" division wall. The chimney is four feet in height, is lined with fire-brick and has a damper tile for each flue. Suitable stoppers in the face wall permit the flues to be cleaned and the appearance of the retorts to be observed. The furnace is slightly bevelled; in this way when the fuel on the grate is burned away, that above will slide down and close in, while it would become thin in the straight furnace, thus allowing more air to enter than is necessary. The furnace proper is constructed of large blocks of an extra quality; throughout the bench generally those portions which are exposed to the direct action of the flames are built of the very best of brick, all laid in the thinnest possible joints. The grate bars are of wrought iron, and the water in the ash pan serves the double purpose of extinguishing the cinders, and of keeping the grate bars cool. The course of the furnace gases is as follows:—From the grate directly upwards, until the circular arch is reached, where they are deflected towards the sides of the bench; a portion of the gases pass through the spaces between the retorts, which thus are completely enveloped. They then pass along the sides of the bench, coming forward by the two flues at the extreme right and left, and then pass to the rear part of the bench by the two remaining flues, and then up the chimney.

Little requires to be said in regard to the iron work of the bench. The mouthpieces have a section 12" × 24", are 15½" deep, and are made as light as possible. They are bolted to the retort, a gas joint being made by means of hydraulic, or, what is still better, iron cement. The retort-lids are of wrought iron; a cotter-bar serves to fasten the lid, while the gas joint is either made by means of ordinary "luting," or by means of a lead ring. Many very ingenious forms of self-sealing retort-lids have been designed in order to obviate the use of the cotter-bar, and their advantages are so evident that in future they will be generally used. The lower part of the face wall is slightly bevelled, the latter being about 4" in two feet; this facilitates the closing of the furnace door, which is protected from the direct action of the fire by means of a fire brick tile.

The amount of skill displayed in working or managing the retorts largely determines, as has already been hinted, the life both of the retorts, and of the setting and bench in general. In starting the fires the same precautions necessary for all fresh brickwork are strictly observed. A small fire is built, the damper is opened but very slightly, and lids are loosely placed upon the mouths of the retorts. The firing is gradually increased until the proper heat for carbonizing is attained; this, of course, varies with the kind of coal, but it may be assumed to be somewhere between 2,000° and 2,400° Fahr. The retorts are constantly

* A Graduating Thesis at the Stevens Institute of Technology.

* October 2, 1876, p. 157.

† This form of setting is clearly illustrated in the British *Journal of Gas-Lighting*, August 8, 1876. The dimensions there shown are greater than those here adopted, and a different kind of hydraulic main is employed.

watched, and any leaks are immediately stopped by means of cement, or, more commonly, by means of fireclay. When a bench requires general repairs the fires are gradually let down, and the last charge of coke is allowed to remain in the retorts until they are cool. In all large works the fires are kept up night and day, but it sometimes occurs that for the purpose of making temporary repairs, they require to be "banked." The dampers once adjusted they are, in most instances, never disturbed; this, it is true, does away with much trouble, but makes it almost impossible to keep up the heats, and there is no doubt that the introduction of some device for closing the dampers when opening the furnace door would materially increase the efficiency of the furnace. It is also evidently better to charge the furnace more frequently and in smaller quantities at a time, rather than fill it with as much fuel as it is capable of receiving. For the purpose, also, of economizing fuel, it is customary, whenever possible, to work such beeches as are adjacent, or placed back to back.

CHARGING THE RETORTS.

The coal in the sheds is broken up into pieces about the size of the fist; it is mixed in the proper proportion, and, the weight having been recorded, it is brought into the retort house in a wagon holding the charge for six retorts. Before deciding upon the weight of the charge for each retort, we must consider that the amount of work which a retort can perform, *i. e.*, the quantity of coal which it is capable of carbonizing in a given time, depends upon the extent of the surfaces which are active during this operation; it is, therefore, desirable to define more clearly this carbonizing surface. In England and on the Continent it is customary to rate as such the "total internal of the retorts sufficiently highly heated to produce gas," and since the whole retort usually has a uniform temperature, this would imply that the entire internal surface is active in carbonizing. In the United States, on the other hand, the carbonizing surface is taken to be that part of the internal surface which is covered by the coal to be carbonized; this latter definition is evidently preferable to the former. No rule exists at present for calculating the area of carbonizing surface necessary to work off a given charge of coal, and experiments in this direction have as yet to be made. It would also be a matter of some difficulty to give a definite rule, since every coal, in order to obtain the best results, requires a temperature somewhat different from that of every other. In determining the charge several things require to be taken into consideration. First, and foremost, that the depth of coal on the bottom of the retort should not be greater than 3", that being about as far as the heat will thoroughly penetrate; and, secondly, that the coke occupies much more space than the original coal If, therefore, the charge be too heavy, the retort is liable to be fractured by the swelling of the coke, and, if this is not the case, there would, at all events, be some difficulty in "drawing" the coke.

For these reasons it was thought advisable to limit the charge per retort to 225 lbs. every four hours. In several works, having even smaller retorts, five hour charges are practiced, and it is, of course, desirable to open the retorts as few times as possible. It is generally held, however, that it is not advantageous to do this, since it is liable to cause the formation of tar rich in oils. A yield of 4·4 cubic feet of gas per pound of coal was here calculated upon; the days' work of each retort, therefore, would be 6,000 cubic feet of at least 16·5 candle gas, very common figures with retorts of our size.

The retorts are charged by means of what are called "scoops,"—semi-cylindrical sheet iron receptacles about 8 feet in length. One-half of the charge for each retort is introduced at any one time by means of the "scoop," which is operated by three men; the lid is then quickly applied and the work of charging a second retort is commenced. In several works the retorts are charged by means of shovels, two men being able to do the work in 1 to 1½ minutes; it is claimed that the coal can be more evenly distributed, while the loss of gas is not much greater than when using "scoops," although the operation occupies more time.

The evolution of gas begins at the moment that the lids are secured; at the expiration of four hours, when the charge is ready to be drawn, the lid is slightly loosened and the escaping gas is fired in order to prevent an explosion. The coke is removed by means of "rakes," is allowed to fall into the "buggies," is then quenched with water, and finally removed to the coke spreading floor where it is screened.

The mode of working the men in the retort-house varies greatly in different works. In some cases six men, three of whom are firemen or stokers, and the other three, helpers, constitute a gang having charge of six benches; in others, three stokers and one helper do the same work; in still another instance, that of a large works, three stokers have charge of six benches, and, while there are no helpers as ordinarily understood, much of the work is done by the "barrow-men" and others employed in and about the retort house. Practice in this vicinity, however, seems to agree upon one fireman or stoker for every two benches of six retorts, and one or two helpers for every six benches. Besides these, in all large works, there are "coke-wheelers," "yard-men," "luters," and others whose duties are sufficiently indicated by their names. The manner of working the retorts, *i.e.*, charging and drawing them, differs in the several works. In some instances a whole bench is charged and drawn; in others, one-half of each of two benches is charged and drawn. It is evident that this latter method is much to be preferred to the former, which is open to the very serious objection, that the temperature of the bench is not only suddenly lowered, but also to a much greater extent than in the latter case, where one-half of the retorts are just beginning and the other half just completing the process of carbonizing. Another important advantage is, that in this manner the men do not interfere with one another as much as when a whole bench is charged and drawn.

[To be continued.]

Spontaneous Combustion of Coal.

By F. A. Abel Esq., F.R.S., and J. Percy, Esq., M.D., F.R.S.

[A paper published in the report of the Royal Commission on the "Spontaneous Combustion of Coal in Ships."]

The so-called spontaneous development of heat which occasionally takes place in coal is due to chemical changes which certain substances occurring in it undergo through the agency of atmospheric oxygen, and which are liable to acceleration by some conditions attending the storage or transport of coal.

The substances, the oxidation of which is attended by the development of heat, are iron pyrites (and possibly some other combinations of sulphur), and some carbo-hydrogen compounds, forming part of the coal itself, which are comparatively readily oxidizable.

Iron pyrites is of almost universal occurrence in coal. The condition in which it exists differs considerably in different kinds of coal; in some it is distributed so as not to be detectable by ordinary inspection; in others it is in form of more or less conspicuous laminæ of a brass yellow color; occasionally, small distinct crystals of cubical form and bright metallic lustre are observed, and not unfrequently it is found in nodules (known as "brasses") and layers of considerable dimensions.

Iron pyrites, a compound of sulphur and iron known as disulphide of iron, occurs in the mineral kingdom in two crystalline forms, which are identical in chemical composition. Pyrites vary greatly as regards their stability or their liability to undergo oxidation by contact with the atmosphere. Some, after remaining unchanged during long periods of exposure, will undergo oxidation without any immediately apparent inciting cause. Others are perfectly stable, and with others, oxidation follows with more or less rapidity upon their exposure to the atmosphere.

The presence of moisture in air promotes the oxidation of pyrites; it does so apparently by bringing the atmospheric oxygen into more intimate contact with the surfaces of the oxidizable material. Similarly the absorption of moisture by mineral substances of laminated or porous structure, through which pyrites are disseminated, promotes the oxidation of the latter by bringing the atmospheric oxygen, which is dissolved by the water, into more intimate contact with the oxidizable material.

Thus, the oxidation of pyrites in alum schist is accelerated, in the manufacture of alum therefrom, by occasionally watering loose heaps of the mineral, which are piled in such a manner that the access of air to the interior can be regulated.

The oxidation of pyrites (as in most instances of chemical action) is accompanied by the development of heat, which may accumulate to such an extent as to lead to the ignition of highly oxidizable constituents of minerals through which it is distributed. Heaps of alum schist, exposed to the air and moistened, will become heated to an extent to lead to the ignition of the carbonaceous constituents of that mineral; and similarly, coal, through which pyrites are disseminated, may become heated to the point of ignition by the oxidation of pyrites disseminated through it.

Sulphur exists in coal in other forms of combination than that of iron pyrites. Thus sulphate of lime is occasionally disseminated through coal; the existence of sulphur in this form cannot give rise to the development of heat, as it is already in the completely oxidized or burnt condition; however, so far as is known, they have not been found to possess any liability to spontaneous heating by oxidation. Some descriptions of coal or shale have been found to contain sulphur in somewhat considerable quantity in combination with carbon and hydrogen. An example of this is furnished by the so-called "resiniferous shale" occurring in Tasmania, which has been found to contain as much as 5 per cent. of sulphur in combination with carbon and hydrogen.

So far as is at present known, the spontaneous heating of coal is not ascribable to any tendency of such sulphur combinations to oxidation by atmospheric agency.

Pyrites appear, therefore, to be the only sulphur combinations occurring in coal which by their oxidation, promoted by the presence of moisture and by mechanical conditions favorable to the accumulation of the heat developed by such oxidation, are liable to give rise to the so-called spontaneous ignition of coal.

Coal varies considerably not only in chemical composition, but in structure, some varities being comparatively open and porous, others coompact or laminated, and very friable or readily broken up.

Carbon in a finely divided or porous condition has the property of absorbing and condensing within its pores large volumes of certain gases, among which is oxygen.

Thus, wood charcoal which has been recently produced, or which has been freshly heated sufficiently to expel moisture and gases which it may have absorbed, will condense within its pores more than nine times its own volume of oxygen, and seven times its own volume of nitrogen, which it is capable of absorbing by exposure to the air.

The condensation of a gas by a porous body is attended by the development of heat, proportionate to the extent of that condensation. Moreover, the tendency to oxidation which carbon, and certain carbon compounds existing in such a substance as charcoal, possess, is favored by the condensation of oxygen within its pores, whereby the very intimate contact between the carbon and oxygen particles is promoted. Hence the development of heat and the establishment of oxidation occur simultaneously; the latter is accelerated as heat accumulates, and chemical action is thus promoted, and may, in course of time, proceed so energetically that the carbon or carbo-hydrogen particles may be heated to igniting point.

A good illustration of this action is afforded by the very porous charcoal prepared for the manufacture of gunpowder. It has to be protected against rapid access of air for some considerable time after it has been removed from the carbonizing retorts (by transferring it at once from the retorts to metal receptacles, which are kept tightly closed for a number of days), otherwise the charcoal, though it may have been allowed to cool down perfectly, will speedily become heated upon exposure to air, by the action above explained, to such an extent as to ignite spontaneously. Even after the stick charcoal no longer exhibits any tendency to heating when exposed, its pulverization by grinding has still to be delayed; otherwise, when the absorption and condensation of oxygen by the internal portions of the pieces of charcoal become favored by the reduction of these to a fine state of division and the consequent exposure of large surfaces to the air, ignition of the charcoal will

take place. (Instances of such ignition upon the mill-beds at powder-works are not unfrequent.)

The spontaneous ignition of oiled cotton or silk waste, or cloths, which is of not unfrequent occurrence, affords another illustration of the manner in which the heat developed by the action of atmospheric oxygen upon readily oxidizable substances, consisting chiefly of carbon and hydrogen, which are exposed to that action under conditions very favorable to it, will readily accumulate to an extent sufficient to give rise to ignition. The porous cotton or silk waste serve, in such cases of spontaneous ignition, as vehicles for exposing the readily oxidizable oil or grease in a finely divided condition to the air, and thus favoring its rapid oxidation.

The foregoing explanation of the manner in which the spontaneous heating and eventual ignition of certain carbonaceous substances, by the action of atmospheric oxygen, are brought about, has a direct bearing on the spontaneous ignition of coal. The more porous and readily oxidizable portions of coal, which are known to be more or less largely disseminated through seams from different localities, undergo oxidation by absorption of atmospheric oxygen, and by the exposure of large surfaces to its action, and the heat developed by that action will accumulate, under favorable conditions, to such an extent as soon to hasten the oxidation and the consequent elevation of temperature, until some of the most finely divided and readily inflammable portions actually become ignited.

The breaking up of the coal, which occurs for a more or less considerable extent before and during its shipment, obviously favors the absorption of oxygen, and consequently increases a tendency to heating by the action above described.

In a series of valuable experiments on the weathering of coal, by Richters and others, it has been demonstrated that a considerable quantity of oxygen is absorbed by freshly-gotten coal, and that carbonic acid and water are evolved from such coal after absorption of oxygen, while a portion of the oxygen absorbed is fixed by the formation of some solid oxygenated compound in the coal. Spontaneous oxidation of coal by the oxygen absorbed from the air is, therefore, satisfactorily established, and is unquestionably one, if not the chief, cause of the spontaneous heating of coal.

Spontaneous ignition of coal, when due to the oxidation of the porous and readily oxidizable carbonaceous substances occurring in coal, does not appear to be favored by the presence of water in the coal, or by its access to a cargo; on the contrary, these portions, by becoming wet, would have their pores more or less filled with water, and their power of absorbing oxygen would be proportionately diminished; hence the presence of water must be antagonistic to the oxidizing action of the latter in many instances, though, when iron pyrites is present, it may promote or accelerate spontaneous heating, as already pointed out.

The gases which are occluded (or confined in a more or less condensed condition) in coal, vary considerably in quantity and composition in different kinds of coal, and they also gradually undergo various changes in composition by exposure, or keeping of the coal.

Their chief inflammable constituent is marsh gas, and it is to the admixture of this gas with a considerable volume of air that explosions are due in freights or stores. In pits where explosions are liable to occur, the gas escapes either with more or less rapidity and force from fissures ("blowers"), or gradually from the freshly exposed surfaces of coal seams. When coal from such pits is brought to the surface, it continues slowly to evolve inflammable gas for some time afterwards, especially if the coal be in large masses, or stored in compact heaps.

If facility is not afforded for the ready escape, or removal into the open air, of the inflammable gas emitted from the coal, composing a cargo or contained in bunkers, on board ship, the spaces between the masses of coal, or any partially confined spaces not occupied by the coal, but in close proximity to, or communication with it, will, in time, become filled with a mixture of the gas with the air in those spaces, which, unless the former be present in very small proportions, would explode on the approach of a flame to it, and with a violence depending upon the proportion which the air bears to the inflammable gas which has become diffused through it.

As the application of flame (or of a body raised to a high red heat) is indispensable to the ignition of mixtures of air with the inflammable gas evolved from coal, it is obvious that explosions cannot occur spontaneously from this cause on board ship, but must be brought about by the accidental or incautious approach of a light to localities where the coal is stored, or where the explosive mixture is likely to penetrate.

If coal, from seams which are charged with marsh gas, is placed on board ship shortly after being raised from the pit, there is obviously great liability to the formation of an explosive atmosphere in the hold or bunkers, or spaces communicating with them, and every possible means should in such cases be had recourse to for facilitating the escape of gas from the coal into the open air.

But, as the gas requires a large admixttre of air to render it violently explosive, it is obvious that any attempt to ventilate the coal by passing or drawing air into the body of the freight would be most likely to favor the production of a violently explosive mixture of gas and air. The only useful application which might be made of any special means of ventilation with a view to diminish the risk of explosions would be to pass a current of air over the coal and immediately into the open air, so as to accelerate the escape and removal of the inflammable gas.

As regards the application of ventilation, with a view to reduce the liability to spontaneous ignition of a cargo of coal, the only useful object which could possibly be aimed at by ventilation, would be the rapid abstraction of heat developed in the coal (by chemical changes set up as described), by causing cool air to circulate freely and rapidly throughout the body of a mass of coal. The attainment of such a result, even by powerful means of artificial ventilation elaborately applied, and with the coal in the mechanical condition most favorable to its free permeation by air, appears, to say the least, very doubtful, and there can be no question that any system of ventilation practically applicable on board ship, would fail to attain such a result, even disregarding the fact that the mechanical (finely divided) condition of much of the coal constituting a cargo is quite antagonistic to the free passage of air through its mass.

It does not appear practicable, therefore, to apply ventilation with any prospect of guarding against the accumulation of heat in some portion of a cargo of coal.

Such circulation of air as may be established even in the less compact portion of the cargo, is not likely to have any valuable cooling effect, and the circulation, if there be any, must be very feeble among the more closely lying masses of small coal, so that heat, if developed in these, will accumulate undisturbed. Indeed, its development would possibly be favored by the fresh supply of oxygen, which a gradual replacement of the air surrounding those parts would convey, so that a period would be reached, sooner or later, when the development of heat would be most seriously promoted by ventilation, some time before actual ignition demanded the total exclusion of fresh air.

The evidence which has been submitted to the committee on the subject of the ignition of coal cargoes bears out generally the conclusion to which the above considerations lead—namely, that it is inadvisable to attempt thorough ventilation of cargoes in coal-laden ships.—*Journal of Gas Lighting.*

Heracline.—Heracline is the name given to a new blasting powder, which has been tried with success in the coal mines of France and Austria. It is composed of picric acid, saltpetre, nitrate of soda, sulphur, and sawdust. The gases produced by its combustion are said not to be injurious, and it burns comparatively slowly, so that it only tears apart the masses blasted, without hurling them violently about. —*Exchange.*

Water Supply Items.

Great Britain.

Water Pipes for Bombay.—The contract for the 18,000 tons of cast-iron pipes required for the Bombay Water Works has been let to Messrs. Laidlaw & Maclaren, of Glasgow. We may add that Mr. John B Manning has been appointed the engineer in England to the Municipality of Bombay.—*Engineering.*

Water Supply of Sydney (N. S. W.)—The government of New South Wales have been appealed to to bring forward a supplementary loan estimate for a sum not exceeding £500,000 towards carrying out, as soon as practicable, such works as will secure a more reliable and ample supply of water to the metropolitan district of the colony. The Premier, while admitting the great importance of the question, intimated that in view of an expected visit from Mr Lindsay, an English hydraulic engineer, who has been specially engaged to report upon the various schemes proposed for increasing the water supply of the New South Wales metropolis, the government considered that it would be unwise to enter upon any large expenditure until that gentleman had reported.—*Ibid.*

London Water.—The sanitary authorities of the city of London appear to be acting with considerable vigor in the matter of the water supply. They have recently taken out several summonses against householders for having on their premises wells supplying water unfit for human consumption, and the facts brought out in evidence clearly show that the water of the wells must be absolutely poisonous. In one instance as much as 385 grains of solid matter were found in a gallon, and Prof. Wanklyn described this water as simply "dituted sewage." Of course these city wells will no longer be used as a source of drinking water, but it should be borne in mind that even the water ordinarily supplied by the various companies is never perfectly safe, especially in hot weather, until it has undergone a second filtration after delivery, for the filtering process adopted at the water works is necessarily very rough and inefficient. The Mansion House has just been added to the list of public buildings fitted with the new main supply filters of the Silicated Carbon Filter Company. These filters are constructed on similar principles to those which have been in satisfactory operation for many years at the General Post, Telegraph, and other government departments, but by a slight modification they are now adapted for either high or low pressure, and can thus be fixed immediately below a water cistern, or attached directly to the company's main, in either case ensuring the perfect purification of all the water that enters a building.—*Ironmonger.*

The Patent Office.—Several changes are impending in the arrangements of this office. An order has just appeared which puts an end to the abridgements of provisional specifications which have, since 1866, been required from each applicant with his provisional specification. This will be a slight relief to inventors, and it is only an official acknowledgement of a fact that has long been obvious to all concerned, that these so-called abridgements were quite useless for any purpose whatever. This order is to take effect on July 1st. Notice is also given that, in future, the drawings accompanying specifications will be reproduced by photo-lithography, and the copies of the originals filed for the purpose of reproduction are, after June 30, to be sent in in a condition such that they may ba copied by means of photography. It is understood that it is intended to make a considerable reduction in the scale on which the drawings are published, with the object of economising space, and lessening the cost of printing. In order to give time for the examination of the filed drawings, the Commissioners of Patents request that they may be sen in at least six days before the expiration of the time allowed, thus limiting by a week the six month's provisional protection granted under the Act of 1852.—*Ironmonger.*

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—Ed.

Dover, Del., Sept. 23rd, 1876.

Mr. Editor: We received a paper to-day with a piece headed New Illuminator—Coal Gas Doomed, and marked with red lead pencil, to call our attention to it. We read it, and found it like hundreds of similar pieces; it described a process for making gas out of nothing, except a little oil and steam, which would cost the consumer less than daylight.

Having read so much in the last five or six years about the *new* processes for making gas from oil, and the cost was nothing compared to coal, we would like to hear of the *first* large gas Co. that ever adopted it permanently, but, in the meantime, we will give you our experience in the gas business. We bought the gas works in this town, not because we wanted them, but because we wanted to use a large amount of gas and could not have it unless we bought the gas works, for the former owner had lost so much money making gas out of wood and oil, that he refused to run the works any longer, although he received $16 per thousand feet for his gas. Of course we profited by his experience and did not attempt to use wood and oil, but tore the works all out and fitted them up for making gas of yellow pine sawdust and resin, which we sold at $8 per thousand the first year, then we reduced the price to $7 per thousand. When we bought the works the consumption was only 300,000 feet the first year. We run the works four years, and the consumption had increased to 1,000,000 feet, when we had to make a change, as we could not make gas enough to supply the increasing consumption. We found the works so much trouble we put an advertisement in the Gas Light Journal for three months, offering the works for sale. At the end of one month we went to the Gas Light Journal to take the advertisement out, as it was more work to answer the letters we received than it was to run the gas works. Of course we told all our correspondents that our works were not fitted for making coal gas, and, therefore, never heard from them again. In the meantime we experimented with coal, and also coal oil, in various ways. We had the best result in oil by mixing it with sawdust, but found the fuel, and wear and tear of retorts alone cost more than all the expenses of making coal gas. We finally tore the works all out, and fitted them up for making coal gas, and also built a new holder. Since then we have had *perfect satisfaction*. We use one 7 ft. retort in summer and two in winter. We bank our fires at night, because we have not consumption enough to run night and day. We use iron retorts and they last about twelve months; our average is 4 38 ft. to the lb. of as good gas as is made anywhere, which we sell at $3.60 per thousand; our consumption is one million and a half, but we could make nearly double that quantity with about the same expense only cost of coal.

There is a gas works in one of our neighboring towns whose experience is just like ours: they used oil, then resin, and now coal; they have no desire to change from coal. There are also works in another of our neighboring towns where they make gas of anthracite coal, steam, and oil, and we think they would be very glad to make the same change we have, judging from what the man told us that runs them.

We forgot to mention that the oil gas destroyed all of our meters, cracked all the leathers so they did not register.

Respectfully yours,
R. & R.

Mr. Editor: The story told on the following slip, cut from the *Evening Telegram*, of this city, although given as "Humors of the Day," has, I think, more value than appears at first sight, and contains a valuable lesson for housekeepers, showing, as it does, how the general cry of the public about high gas bills and "extortions," may be very properly met by the gas company by "extravagance:"

"A farmer up the river sold out a few weeks since and came to New York to live. He had never had any experience with gas, of course, but he imagined that he could easily run half a dozen gas-burners after one night's experience. He was pretty lavish of the vapor, and when his bill was sent in he looked upon it as a downright swindle. He could not understand the meter, and, believing that the gas company wanted to impose on him on account of his being a new-comer, he swore by the great horn spoon that he would get even in some way. He was telling one of the dealers at the Essex Market about his trouble, and after hearing the story out, the man said:

'Well, it's very wrong for the company to act that way, and I don't blame you for feeling revengeful. They swindled me that way when I first came, but I had revenge. I went home and lit all the burners in the house, and kept them going night and day for three weeks. I came pretty near breaking the company down.'

The hint was not lost on the new-comer. He went home and followed the dealer's advice to the letter, and for the next three weeks he was happy. He walked about feeling that he was at least a neck ahead, and though he felt a little pity for the company, he would not turn off a single burner. When the gas man next came around and read the meter he jumped four feet high with sudden astonishment. He asked the householder what he had been doing, and when an explanation was made he had something to say that put a flea in somebody's ear. He was grinning a terrible grin when he went out, and the householder was leaning against the wall, white as a sheet, and gasping out:—

'W-what—f-i-f-t-y dollars!'"

Now, as an addition to the above, which shows what may be accomplished by "keeping a'going night and day," allow me to give you four months' observations of what may be obtained by properly attending to the burners, etc, and for this purpose I give below the amount of monthly gas bills of three small families, where the gas has been used *for cooking and lighting*—

1.—May	$2.50	total burners at disposal 12. 6 rooms and kitchen.
—June	2.00	
—July	1.85	
—Aug	3.00	

In this family a so-called double gas-stove is used, and generally two lights, one of which is an argand burner; very often, however, four and five lights are used during the evening. Lights are extinguished about 11 P. M., or somewhat later. *All* the cooking is done by gas except on washing days.

2.—May	$2.75	total burners at disposal 11. 5 rooms and kitchen.
—June	2 10	
—July	2.45	
—Aug	2.75	

occupy a so-called french flat, use single gas-stove, and two lights generally, more whenever there is a call for them.

3.—May	$2.00	total burners at disposal 9. 5 rooms.
—June	1.00	
—July	1.35	
—Aug	1.60	

These latter are my own bills, and are the result of four months experiment of what can be done for a family of four adults, using gas for cooking and lighting, by *strictly preventing any waste* without any *curtailment* of useful light. We use two or three lights, and a "single" gas-stove. The burners are the worst possible, being those which were on the brackets, etc., when we moved into the house—rusted. All I have done to them is to remove the rust from the tips, and open the holes with a common pin, my object being to find out what can be done by using the fixtures at disposal of most families in this city. We make it a *strict rule* that the last person leaving a room must turn off the gas so far as to leave only a flame of 1 inch or ¾ inch high (same as a common candle), which is just sufficient to show every object in the room to every one entering, so that any one can, on entering the room, easily reach the gas fixtures and turn the lights on. I use in the hall a 2-feet burner (new), and in the sitting room one argand burner (droplight) during the whole evening, while the other burners are used as wanted. Whenever there is more light wanted nobody hesitates to use it, but nothing is wasted, and no appliance used which is not at command of every housekeeper.

I will add, that my last year's bills were about the same as the first three months of family No. 1. Why do not the gas companies print instructions, say on the back of the bills?

Query. 100 consumers at $8.00, or 1000 at $2.00. Which is the best?

Employees of W. W. Goodwin & Co., Gas Meter Manufacturers.

Centennial Grounds, Pennsylvania Day,
Sept. 28th, 1876.

At a meeting held this day at the Centennial Grounds, the following resolutions were unanimously adopted:

Resolved, That we, the employees of W. W. Goodwin & Co., take this method of returning our sincere and heartfelt thanks for their unbounded liberality in granting us all necessary means for fittingly celebrating Pennsylania's Centennial Day at the Exhibition Grounds, leaving nothing undone to give us all that was possible for our enjoyment and comfort.

Resolved, That we highly appreciate the close and kind attention of Mr. W. W. Goodwin in accompanying us to the various points of interest, and remaining by us during the best part of the day.

Resolved, That in the future, as in the past, we will labor to advance our employer's interest, in appreciation of this, one of many favors received at their hands.

Resolved, That a copy of the above resolutions be forwarded to Messrs. Goodwin & Co., and published in American Gas Light Journal, of New York, and the *Ledger* and *Times* of Philadelphia.

Jas. Hall Chairman of Committee.
D. P. Vandergrift. }
Robt. Jones. }
Wm. Lettinger. }
John Schatt, Jr. } Committee.
L. J. Gilbert. }
Adam Roehm. }
John M. Carroll, Secretary.

Crystallized Glycerine.

BY DR. PAUL F. VAN HAMEL ROOS.

According to an observation of Whöler in 1867, the glycerine seems to get in the solid state by exposing it continually to movement at a low temperature.

As I have had the opportunity of experimenting on crystallized glycerine, I beg to call attention to the following points:

It seems that the glycerine, only by being in the highest state of chemical purity, can be solidified.

When this chemically pure and perfectly anhydrous crystallized glycerine is melted and afterwards exposed to a temperature of 30° F., the smallest crystal of crystallized glycerine transforms all the liquid again to a solid body.

If the temperature is 24° F. the transformation is *spontaneous*; *i. e.*, without putting any crystal into the melted glycerine it gets solid by *stirring* the liquor vigorously. The sp. gr. of this glycerine is, at its melting point 60° F. 1·261.

When this glycerine is exposed to the action of hydrocyanic acid, no alteration in the color can be observed after several weeks.

If it is mixed with yeast and exposed to a temperature of 70° F. to 80° F. no fermentation results (after two or three weeks of contact.) Prof. Redtembacher describes such a fermentation, with propionic acid as one of the results. No acid has been observed in the mixture of glycerine and yeast. If a glycerine contains one tenth per cent. of water or more, the solidification is impossible.

The crystal of glycerine seem to have a prismatic form, but it is very difficult to undertake crystallographic measurements, the melting-point being so low and the crystals very small. I am trying to get bigger crystallizations, and I hope to be able to mention soon some other experiments about this rare material.—*Chem. News.*

Stirling Chemical Works, Stratford, E.

Gas-Light Intelligence.

United States.

Explosion at the Washington Mills Gas Works, Lawrence, Mass.—About 7 o'clock, Saturday evening, a heavy explosion occurred at the petroleum gas works of the Washington mills. The shock was heard or felt on Essex street, as far east as the Everett mills and as far west as Amesbury street. The explosion was followed by a flash of light, and fire alarms were rung in from boxes 5 and 32. There was no fire, however, to require the services of the steamers, and the damage to the works was very slight. At the time of the explosion, it appears that John Roberts, who has charge of the works, was filling the petroleum cisterns, which are placed under ground in the gas works yard, with oil from tank cars on the canal railroad tracks. Mr. Roberts has made no statement as yet as to the circumstances of the explosion. He was thrown by the force of it about twelve feet, receiving a severe shock, and having his face considerably burned. He received no injuries, however, which the physicians consider dangerous, though he is confined to his residence—No. 47. Newbury street. It seems probable that Mr. Roberts held his lantern over the petroleum cisterns to ascertain how nearly full they were, and that the gas, coming in contact with the light, caused the explosion. His broken lantern was found on the ground. The occurrence caused wild rumors in the city, Saturday night, as to the amount of damage done, and has occasioned inquiries to some extent into the circumstances under which the permit for the construction of the works was obtained from the city. But, according to all which can be learned of the origin of the accident, it did not arise from gas-manufacture. The explosion was one likely to happen in a grocery store or in any place where a man can be found careless enough to approach a cistern filled with petroleum with a lighted lantern. Mr. Roberts had most positive instructions that he must never approach the tanks with a lantern, and printed notices to the same effect have been keep posted at all times in the gas-works yard. The explosion blew off the roofing over the cisterns but did not ignite the petroleum.—*Lawrence Paper.*

Great Britain.

We take the following gas items from the London *Journal of Gas-Lighting:*

Reductions in the Price of Gas.—The Liverpool United Gas Company have announced a reduction in the price of gas to the uniform rate of 4s. per 1000 cubic feet, such reduction to take effect from the 1st of October next. At Willingborough the price will be reduced from 4s. 9d. to 4s. 6d. at Michaelmas, and at Melton Mowbray to 4s. 7d.—*Jour. of Gas-Lighting, August.*

Combustion of Coal Gas.—At the late meeting of the British Association in Glasgow, the following gentlemen were nominated by the Chemical Section to act as a committee to investigate and report upon the best methods of developing the greatest illuminating power in the combustion of coal gas of various qualities: Dr. William Wallace; Glasgow, secretary; Prof. Dittmar, Andersonian University, Glasgow; Mr. Thomas Wills, F.C.S., London. A small grant of money has been voted by the Association for the purpose.

Gas Explosion in a Church.—A serious explosion occurred on Wednesday evening last (Sept. 13), in the church of St. John, Maddermarket, Norwich. The minister of the parish, the Rev. Mr. Ramsby, and the choir boys were about to engage in choir practice, when, on a light being applied to one of the burners a large body of gas, which had escaped, exploded. The effects of the explosion were most severe, several windows (one of them filled with stained glass) being blown out, while the fittings of the church were also much damaged. Mr. Rumsby and one of the choir boys were hurt, but no lives were lost. The floor of the church was completely torn up, and a portion of the woodwork of the pulpit was also damaged. Some of the windows in houses adjoining the church were also blown out by the explosion.

Supplanting Coal Gas.—The various schemes brought out in late years for supplanting coal gas have proved signal failures. Our advertising columns have recently shown that two of these schemes are now placed in the market by the liquidators of the companies who brought them out. It is not for us to gauge their value; inventors must decide on that for themselves. We need only remark, that the continued rise in the price of petroleum, which promises to go on increasing in value, must exercise great influence on the terms which will be offered, irrespective of any opinions that may be entertained as to the merits of the inventions. We shall be curious to learn what is offered for an invention which was once sold for £100,000, the half of which was, we believe, actually paid in hard cash.

Alleged Swindling by a Gas Manager.—William Milner Barrett, a native of Swineffeet, near Goole, and by profession a manager of gas-works, is now in the custody of the police, charged with obtaining six wagons of coal from the Silkstone and Dodsworth Colliery Company by false pretences. It would appear that the firm of Newton, Chambers & Co., had been induced, just lately, to send a quantity of coal to Eastrington, and Mr. Barrett, who was then called Williams, managed to get possession of the coals on showing an advice note, and he sold them. The thing was, of course, found out; and, on the Silkstone and Dodsworth Colliery Company being subsequently duped in a like manner by the sending of coals to "Riccall Gas Works," the matter was then taken up by Mr. Superintendent Campbell, of the North Eastern Detective Police. Detectives Porteous and Heldith succeeded in capturing the man of York.

Destructive Explosion of Gas.—An explosion of gas occurred on August 9th at the residence of Mr. Thomas Westley, brassfounder, Albion street, Birmingham. A gasman in the employ of the Corporation had been attaching the service-pipe at Mr. Westley's house to a new main in the street, and in doing so disturbed a pipe connecting the service-pipe with the meter in the cellar of the house. The result was that the gas poured in full force into the cellar. About half past six o'clock Mrs. Westley was about to go into the cellar with a lighted taper, when the gas ignited and exploded with tremendous force, wrecking the house from roof to basement. Mrs. Westley was severely burned about the face and arms, but fortunately escaped with life. The ignited gas in its attempt to find a vent forced its way through the ceiling of the cellar into the room above, and after driving the wall of that room outwards for several inches, ultimately lifted the roof of the bay window bodily out of the framework, the *debris* falling into the room. The house is considered to be irreparably shattered, the damage being estimated at several hundreds of pounds.—*Ironmonger.*

The Pavement of Milan.—At this moment, when the "battle of the pavements" is still engaging public attention and dividing and puzzling the members of vestries and local Boards, a few words to describe the excellent system adopted at Milan may be welcome to all who are interested in this important question. On each side of the streets there are two lines of flag-stones, sufficiently broad to bear the wheels of every sort of vehicle. Between these parallel lines the pavement consists of small unequal stones, on which the horses may step with security and without the least fear of slipping. On the other hand, the wheels of the carriage revolve easily, smoothly, and without the slightest noise, on the even surface of the flag-stones. Of course, these slab stones and the smaller pavement are kept on the same level, so that a carriage may be driven off the line, to turn, or outstep another vehicle in front, without the least impediment. Practically, and so far as we are aware, this system has given rise to no inconvenience, and combines the rival advantages of pavement and asphalte; but we should recommend visitors to the Corso at Milan to judge for themselves.—*The Builder.*

Chemical and Scientific Repertory.

Greiner Defines steel to be "all malleable irons obtained in a state of fusion," or, what is the same thing—all cast malleable irons.—*The Polytechnic Review.*

Cape Diamonds.—It is estimated that the value of the diamonds found at the Cape from March, 1867, to December 31, 1875, exceeds twelve millions pounds sterling.—*Ibid.*

Artificial India Rubber.—A cheap and useful substitute for India-rubber is prepared by mixing a thick solution of glue with tungstate of soda and hydrochloric acid. A compound of tungstic acid and glue is precipitated, which, at a temperature of 86° to 104° Fah., is sufficiently elastic to admit of being drawn out into very thin sheets. On cooling, this mass becomes solid and brittle, but on being heated again, soft and plastic. This new compound can be used for many of the purposes to which rubber is adapted.—*New Remedies.*

Cornish Pumping Engines at Providence, R.I.

We learn from the Providence *Bulletin* that the Cornish pumping engine at Pettaconset seems to be fully justifying the anticipations of its projectors. For some days past, with the use of Cumberland coal, delivered at a cost of five and a half dollars, the engine has been quietly doing a duty of 95,000,000. All the indications so far are that, as a permanent, reliable, economical pumping engine, it has probably no equal in the country. It is encouraging to learn in this connection that the experimental filter basin at the pumping station, which comes into use with the new engine, promises to afford all the water needed for the present supply, without further drawing direct from the river.—*Eng. News.*

Suez Canal.—Less dredging work was required at Port Said last year than in 1874. The quantity of stuff dredged out of the great Ismail Basin at Port Said in 1875 amounted to one hundred and eighty thousand cubic metres; the removal of this stuff secured the basin its maximum depth throughout. The maintenance of the sidings and bed of the canal last year involved the dredging of 721,000 cubic meters. The quantity of stuff removed in 1875 between the two seas only amounted to 52,700 cubic meters. The quantity of stone used during the year in facing banks amounted to 24,500 cubic meters. The canal was navigated with facility last year by steamers drawing nearly 27 feet of water, and 430 feet in length.—*The Engineer.*

Sewerage in Boston.—Three engineers, under the supervision of Mr. E. C. Clark, are now engaged in surveys for the proposed new main sewer in Boston. One is at Moon Island making surveys, another making observations with reference to the currents prevailing in the harbor by means of floats, while the third is employed in artesian borings to determine upon the feasibility of tunneling the Neponset river, Mr. Clark, the engineer in charge, was resident engineer of the Detroit tunnel, and of the last tunnel under the city of Chicago. He has also been connected with sewer work at Chicago and in Philadelphia.—*Eng. News.*

The water system of Dubuque is quite a novelty. In one of the bluffs a lead mining company met obstruction from water, and to obtain relief the bluff was tunneled, when it was found that a copious fountain had been struck which ran to waste for several years. But the water was most excellent, the supply exceedingly liberal and the head so elevated that the idea of utilizing it was seized by a company, the property purchased, and a system perfected which gives the cheapest and best water supply known in the country, furnishing the city for all purposes at an ex

pense of $8000 per year. There is also a sufficient supply to be used for water power.—*Ibid.*

GERMAN AMBER.—The extent of the amber fields in Germany may be seen from the fact that twenty-two dredges, two tug boats, one hundred barges, and one thousand laborers are engaged in the indnstry. The area of the amber field is extensive. and the Government derives from it a yearly rent of 72,200 thalers. —*New Remedies.*

SEWAGE AT TROWBRIDGE.—M. Fulda, a French chemist, has been experimenting with the sewage at Trowbridge. The sewage flows into a tank in which an agitator is worked bp a small steam engine to keep certain chemicals in operation. The contents flow off at a two-inch fall into another tank, where the solid portions of the sewage are rapidly precipitated to the bottom, and the effluent water runs into another tank, where further precipitation takes place, and the water flows thence clear and bright into the river. The expense of the whole apparatus is at the rate of 2*l.* for every million gallons of sewage, the residium forming a portable manure. M. Fulda's system is in operation at the cloth mills of Messrs. Pratt and Sons, at the Bromley Union Workhouse, and other places. The cost of a plant to work his process M. Fulda estimates at 320*l.*—*Engineering.*

NEW COMPENSATING PENDULUM.—Prof. J. Lawrence Smith has recently invented a new compensating pendulum, in which he avails himself of the great expansibility of ebonite, which, between 32° and 158° Fah., approaches that of mercury. The pendulum rod is of steel, with an adjusting screw at the lower end; and a round rod of vulcanite, with a hole in the center, is passed on to the steel rod by fitting it loosely and being held in place by the adjusting screw. The bob of the pendulum consists of a heavy piece of brass, with a hole through the center large enough to admit the vulcanite, over which it passes, and, by a properly arranged stop, rests on the end of the vulcanite furthest from the lower end of the pendulum, so that any expansion of the vulcanite elevates the brass bob, thus compensating for the downward expansation of the steel rod and brass bob. Professor Smith says that four months' use of this pendulum on an astronomical clock has given very satisfactory results. It can be adapted, at a cost of 20 cents, to the ordinary mantlepiece clock, the pendulum of which usually beats in half seconds.—*Scientific American.*

Illumination of Lighthouses.

M. E. Allard, engineer-in-chief of the Administration of Lighthouses, has lately brought before the Paris Academy of Sciences some papers on the illuminating power of the flames employed for illumination, their transparency, and the translucency of the atmosphere The first paper treated on the transparency of flames. The burners used in lighthouses have diameters of from 1 to 5 inches, and carry from 1 to 6 concentric wicks. In measuring the luminous intensity of the flames which they produce, it is found that these intensities increase a little less rapidly than the consumption of oil, and also that the intensity for each 1-7 of a square inch of apparent surface increases, while, on the contrary, the intensity for each 1-16 of a cubic inch of volume diminishes in direct proportion to the diameter. These results can only be explained by admitting that the transparency of the flame is not absolute.

This is the object of the first investigation made by M. Allard; he has determined the co-efficient of this transparency by three series of experiments: by measuring the intensity of different flames with a flat wick looked at sidewise or edgewise; by means of a curved mirror, which reflects towards the focus the rays which it receives, and thus causes them to pass through the flame; and by measuring the intensity of an electric light across a flame of large diameter. These investigations have led to the adoption of the number0·8, as a mean value of this co-efficient reduced to a thickness of 0·39 inch in the flame passed through. One important conclusion is arrived at, namely, that the total quantity of light produced, or the absolute intensity, increases much more rapidly than the weight of oil consumed; but as the quantity of light absorbed, by the passage of the rays across the flame itself, increases in a still greater proportion, the difference between these two quantities, or the effective intensity, follows a law of augmentation a little less rapid than the consumption of oil.

M. Allard was next engaged on the translucency of the atmosphere. The observations made by lighthouse keepers on the visibility of neighboring lights consisted in noticing, three times each night, whether each of the lights could or could not be perceived, so that it might be ascertained, at the end of a certain number of years how many times out of a hundred each of these lights was visible. A diagram showed, for each of the lights noticed, what is the limit of translucency in which it ceases to be perceived from the place of observation.

In another paper M. Allard has studied the impressions produced on the organ of sight by flashing lights. It appears that, by causing a series of flashes to be succeeded by equal intervals of darkness, each flash at moderate speed produces the same effects as if in an isolated state; in proportion as the speed increases, the impression on the retina is prolonged, and after a certain speed the effect is that of a constant light.—*Scientific American.*

Testing for Water in Coals.

BY MR. J. BLODGET BRITTON.

[A paper read before the American Institute of Mining Engineers, at the Philadelphia meeting, June 26, 1876.]

Six different samples of anthracite, each a firm compact lump, were finely pulverized and immediately put in bottles. Portions of these were weighed and placed upon an ordinary water-bath, and dried for one hour; the average loss was 1·24. The same portions were then placed in a hot-air oven, and for two hours kept at a temperature of 285° Fahr., and after cooling in a dry chamber, were again weighed, when there was found a further average loss of 1·22, making a total so far of 2·46. They were then immediately returned to the oven, and for two hours more kept at a temperature of 530° Fahr., and cooled and weighed again, when no further loss was found, but an average gain of ·55 upon the previous weighing. The same portions were a third time placed in the oven, and for about ten minutes kept at the last mentioned temperature, and then, while still hot, were poured into one-quarter inch glass tubes, each with a bulb at one end, and tested over a Bunsen burner at a temperature below a red heat, when more water vaporized and condensed in small clear globules at the cold parts of the tubes.

Fresh portions of the coal were then taken, and the total amount of water determined, and the average was found to be 3·04 or 1·80 more than was found at the temperature of the water-bath, which was perhaps a little below 212° Fahr., and ·58 more than at 285° Fahr.

Tests were afterwards made by placing other fresh portions of the coals within a bell-glass over strong sulphuric acid for more than 26 hours, when the total average loss was found to be 1·91, or 1·13 below the amount of water actually present in the coals. Upon allowing some of these last portions to remain in the open air for a couple of hours, they were found to have nearly regained their original weights. Additional fresh portions were then weighed, and left exposed to the open air of the laboratory; the next day they were weighed again and found to have gained an average of 1·03. This gain proved to be due almost entirely to moisture absorbed.

A sample of bituminous coal from Clearfield county, Pennsylvania, was treated very nearly in the same manner. Dried on the water-bath for one hour, it lost 1·69; dried in the hot-air oven for one hour at 250° Fahr., the loss was less, being 1·65, and for another hour at 280° Fahr., the loss remained nearly the same, 1·66. Being a third time returned to the oven, and kept for about two hours at 580° Fahr., the loss was increased to 2·14. The coal was then tested in a bulb-tube over a Bunsen burner at below a red heat, and the presence of water in the sample was subsequently found to be 2·46, or .77 more than the loss, at the temperature of the water-bath, and ·32 more than at the temperature of 580° Fahr.

Another sample of bituminous coal from Huntingdon county, Pennsylvania, upon drying on the water-bath for one hour, lost in weight ·76, and after being kept in the oven at 545° Fahr., the loss was reduced to ·35; upon then being tested in a bulb-tube over a Bunsen burner, water was detected. The total amount of water found in this sample was 2·02, or 1·26 more than the loss at the temperature of the bath.

A sample of gas coal from West Virginia gave very similar results. Another sample of the kind of coal from the Kanawha river, upon exposure in the oven for one hour, at about 560° Fahr., was found not to have lost, but to have gained nearly one per cent. over its normal weight, and then when tested in the bulb-tube over a Bunsen burner, gave off a very appreciable amount of water.

Quite a number of analyses were made of the tru brown coals or lignites of Southern Arkansas, to as certain their value for the production of paraffin, an it was found that they did not part with all their wate which amounted to an average of about 19 per cent. until destructive distillation commenced. A portion of a sample of coal from east of the Rocky Mountains on the line of the Union Pacific Railroad, was placed in the hot-air oven, and for an hour and a half kept at a temperature of 170° Fahr., when it was found to have lost in weight 5·72; kept for one hour more at a temperature of 280° Fahr., the loss was increased to 7·31; and again for two hours more at the same temperature, the whole loss was found to be 7·55. Another portion of the same sample was then subjected for three hours to a temperature of 500° Fahr., when the loss was further increased to 1·55. The watery vapor from this last portion was condensed in a cold glass tube, the tube was carefully weighed, aed then the water cautiously evaporated; afterwards the tube was weighed again, and, from the loss, the weight of water was ascertained. The coal was then weighed, and its loss was found to correspond very nearly with the weight of the water. Upon immediately testing it in a bulb tube over a Bunsen burner, more water passed off; and upon continuing it over the burner at a high temperature, white fumes and a dark brown oil passed off, but no more water. The actual amount of water in this sample was subsequently found to be 12·50.

I have made many other experiments, the results of which I need not give in detail: collectively they have tended to prove—

1. That water exists in the several classes of coal in two conditions, that is, combined and uncombined, but, in these conditions, not constant in relative proportions.

2. That some coals will, and some will not, irrespective of the class to which they belong, when finely pulverized and left open to the air, gain in weight by taking oxygen, while at the same time they lose in weight by losing water and hydrocarbons, at temperatures varying between that of boiling water, and one that is sufficient for destructive distillation.

3. That all coals, when deprived by heat of any portion of their normal water will, upon exposure to the open air at common temperatures, immediately begin to regain their loss. It therefore follows that correct weighing cannot be done with the material unenclosed.

4. That the method of determining the water by merely finding the loss which the coal sustains by drying for one hour at 212° Fahr., or for any length of time, or at any temperature, whether over sulphuric acid or not, gives fallacious results.

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

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MONDAY, OCTOBER 16, 1876.

Railway Resistances.

An interesting report on this subject was made at the recent meeting of the American Institute of Civil Engineers, by a committee consisting of Messrs. W. P. Shinn and P. H. Dudley. Of this report the *Railway Review* makes a most interesting synopsis. It is self-evident that it takes more force to pull a given train over a rough road than over a smooth one, and that it makes considerable difference whether a train is moving over a horizontal or an inclined track, straight or curved, and whether the journals are properly or improperly lubricated. These, with many other conditions must enter into the questions of how much force is required to move a train of a definite weight between two given points. The question is an economical one of no little importance in these days, when the grand desideratum is to reduce the cost of transportation. The *Review* says:

In order to ascertain how many foot pounds were necessary to move a train of given dimensions, Messrs. Shinn and Dudley used a very ingenious contrivance called a dynagraph (the invention of the latter gentleman), attached to the car next to the locomotive. This instrument consists of a steel cylinder filled with oil into which is fitted a cylinder to the piston of which is attached the draw bar of the car. The varying degrees of force exerted upon this draw bar are communicated to the piston and through that to the oil, which in its turn impresses the force upon a series of springs of known tension. These springs are attached to a recording apparatus something like that of an anemometer, by which a pencil records the speed and the actual force used. By this means it can be ascertained at any place on the road passed over how many foot pounds were required, and, of course, how much fuel was used. These dynagraph records have been made throughout the entire length of the Lake Shore and Michigan Southern Road, from Buffalo to Chicago, and the data are being worked out. Some of the results already arrived at are of curious interest. It is ascertained that there is a great waste of power caused by stoppages, requiring extra consumption of fuel to overcome the inertia of the train. In one case it was found that 125 pounds of coal were consumed in merely starting a train. The amount of force is readily found by dividing the force registered on the dynagraph by the number of foot pounds of force developed by a pound of coal, which in the case of the engine used was 296,545 pounds. The dynagraph was so sensitive that it recorded every movement of the lever of the throttle valve, of the reversing lever, and even the opening of the cylinder cocks. Even the resistances of the track caused by heavy moisture are readily indicated and recorded. It was found that a large outlay of extra force is frequently necessary on account of defective or poor lubrication. In one case where the oil had become mixed with particles of brass worn from the bearings, when fresh oil was turned into the boxes the power required to move the train was decreased from 10 to 20 per cent. Another interesting conclusion arrived at is that fuel is saved by running heavy freight trains at a speed of from 18 to 30 miles per hour rather than at the usual low speed of 12 miles per hour. Of course, as a question of economy, it may be found that the extra wear of the road and the rolling stock will balance or exceed the saving of fuel. But it seems to have been settled that light gradients are overcome much more easily by an increased velocity just before attempting them.

These investigations also show a great waste of power caused by the dspression of the ends of rails. These depressions are not noticed by passengers on account of the excellent springs of the passenger coaches: but the dynagraph gives immediate and reliable notice that a great increase in the consumption of coal is necessary to overcome the jolts caused by such defects in the track. The experiments so far made by the dynagraph indicate that this new field of investigation will develop some very important results in the operation of railways and the saving of unnecessary cost in the department of transportation. —*Iron Age.*

Memorial to an Engineer.—A bronze statue of the late James Carmichael, the celebrated engineer, from the chisel of Mr. John Hutchison, R.S.A., was on June 17 unveiled in Dundee, in presence of a great concourse of spectators. The ceremony was held on the centenary of the birth of Mr. Carmichael. Some time ago the idea of erecting a statue to perpetuate Mr. Carmichael's memory was mooted, and was so warmly taken up by the leading citizens that the necessary funds were speedily procured. Mr. Carmichael was the inventor of the fan-blast and of many improvements in mechanics. The statue and pedestal rise to the height of 17 feet. Mr. Carmichael is represented in sitting posture, examining a plan, with miniatures of his inventions on the plinth. The statue is erected on the grounds of the Albert Institute.—*The Ironmonger.*

Price of Gas.

The following prices are *official*, having been furnished to the AMERICAN GAS-LIGHT JOURNAL by the officers of the various Gas Companies.

Albany (Peoples) N. Y.	$2.75	
Annapolis, Md.	3.40	
Atchison, Kansas.	4.50	
Austin, Texas.	6.00	
Allegheny City, Pa.	1.80	20 p. ct. off prompt pay
Albany, N. Y.	2.75	
Ashland, Ohio	3.50	Street lamps 4½ hours 17 nights per month $15 per annum.
Augusta, Ga.	4.00	Net.
Anderson, Ind.	3.50	Crude petroleum.
Ashtabula, Ohio	2.00	Wren's process; $10 for 80 candle gas.
Auburn, N Y.	3.50	5 p c off prompt pay.
Allentown, Pa.	2.50	$18 per an street lamps Meter rent 10 cents per month.
Ashland, Pa.	10.00	70 candle gas, 10 p c off prompt pay. Patton's process.
Brooklyn, B'klyn.	2.50	
Brooklyn, Citizens.	2.25	
" Nassau.	2.75	
" Metropol'an	2.50	
" Peoples.	2.50	
" W'msburgh	2.75	
Brockton, Mass.	3.80	
Batavia, N. Y.	3.00	
Bridgton, N. J.	3.50	
Bangor, Me.	3.00	
Boonville, Mo.	4.50	
Brownsville, Tenn.	4.50	
Belfast, Maine	4.00	10 p. c. off bills over $10; 5 p. c. off bills under $10.
Brockville, Ontario	3.75	
Bloomfield, N. J.	3.75	
Belleville, Ill.	3.50	
Bellaire, Ohio	2.85	5 p ct. off prompt pay.
Barnesville, Ohio	3.00	5 p ct. off prompt pay. Street lamps $17.50 per ann. Burn till 12 P. M. on moonless nights.
Boston, Mass.	2.25	
Bath, Maine	4.00	12½ p c off prompt pay.
Bayonne City, N. J.	4.00	Net.
Binghampton, N. Y.	4.00	10 p c off prompt pay on bills for 1000 per month.
Buffalo G L Co., N Y.	2.50	10 p c off prompt pay.
Buffalo Mutual, N Y.	2.50	10 p c off prompt pay.
Buffalo Citizens, N Y.	2.50	10 p c off prompt pay.
Bloomsburg, Pa.	10.00	70 candle gas, 10 p c off prompt pay. Patton's process.
Burlington, Iowa	3.75	15 p c off bills of $100, and 2g p c over $200. Street lamps $25.22 each, per annum.
Cleveland, Peoples, O	2.00	
Cumberland, Md.	3.00	
Charleston, W. Va.	4.00	25 p. ct. off prompt pay Meter rent 25, 30, and 50 cents. per m. for 3, 5 and 10 light.
Cincinnati, Ohio	2.25	
Columbia, Mo.	4.50	
Carondolet, South St. Louis, Mo.	3.00	5 p. ct. off prompt pay,
Chattanooga, Tenn.	3.00	
Cold Water, Mich.	3.25	
Chicago, Ill.	2.50	
Columbia, Pa.	2.85	Lowe process.
Charlottesville, Va.	2.50	Meter rent 20 cents.
Cedar Rapids, Iowa.	4.50	50 cts p M. off prompt pay.
Cairo, Ill.	3.75	50 cts added if not paid by the 5th.
Cortland, N. Y.	4.00	25 cts p M. off prompt pay.
Cairo, Ill.	3.75	50 cents per month off prompt pay. For 20,000 feet a month $2.50.
Chillicothe, Ohio.	3.00	
Camden, N. J.	3.16	5 p c off prompt pay; 10 p c off for 100,000 per year.
Carson City, Nevada	8.00	Gas from wood and Cannel coal.
Cadiz, Ohio	3.50	10 p c off on 500 feet or less; 50 cts per M. on from 500 to 2000; 20 p c off on 2000 and upwards.
Charlestown, Mass.	2.75	
Derby, Conn.	3.60	10 p. c. off prompt pay, and 50 cts per M. on excess of 5000 ft. per month.
Decatur, Ill.	3.50	50 cts. per M. added, if not paid by 10th.
Danbury, Conn.	4.28	For less than 5000 per month.
" "	3.85	For over 5000 per m th
Dover, Del.	3.60	
Dunkirk, N Y.	2.50	Street lamps till 12, moonless nights $25 per annum.
Defiance, Ohio.	10.00	70 candle gas, 20 p c off prompt pay. Patton's process.
Delaware, Ohio.	3.00	No charge for meter.
East Boston, Mass.	3.00	
East St. Louis, Ill.	3.50	5 p. c. off prompt pay.
Evansville, Ind.	3.00	City lamps $30.
Erie, Pa.	3.00	City lamps $28 p. an.
Elkhart, Ind.	3.50	
East Newark, N. J.	4 00	
Eastchester, N. Y.	3.50	
Elizabethtown, N. J.	3.00	
East N Y (Union) L I.	3.00	
Eastport, Me.	4.00	
Fredericksburg, Va.	3.40	
Flint, Mich.	3.50	
Franklin, Pa.	3.00	
Fall River, Mass.	3.00	
Freeport, Ill.	3.80	
Fort Scott, Kansas.	4.50	
Flatbush, L I.	3.50	
Fredonia, N. Y.	3.00	Street lamps $25 per annum; burn till 12 P. M.

Guelph, Ontario	3,50	
Geneva, N, Y	2.50	5 p. c. off prompt pay. Wood and oil gas.
Greensboro, N. C	4.00	
Galena, Ill	4.50	Meter rent 25 cts. per month.
" "	4.00	After September 1st.
Grand Rapiids, Mch	2.80	For less than 1000 feet per month.
" " "	2.50	For over 1000 eet per month. 10 per ct discount on 300,000 ft annually
Gloucester, N. J	3.15	5 p c off prompt pay.
Greenwich, Conn	2.40	Wren's process
Goshen, Ind	10.00	70 candle gas, 20 p c off prompt pay. Patton's process.
Galesburgh, Ill	3.50	10 p c off prompt pay.
Huntsville, Ala	3.50	
Hempstead, L. I	4.00	
Huntingdon, Pa	3.80	10 per ct. off prompt pay.
Hagerstown, Md	3.75	
Hamilton, Ohio	4.00	
Hillsdale, Mich	3.50	
Holyoke, Mass	3.01	
Hartford, Conn	2.75	
Hornellsville, N. Y	3.50	50 cents per 1000 off prompt pay.
Honesdal e, Pa	4.00	12½ cents meter rent per month.
Hannibal, Mo	3.00	No meter rent.
Ithaca, N. Y	4.00	5 p. c. off prompt pay.
Indianapolis, Ind	2.50	
Indiana, Pa	3.00	10 p. c. off prom pay Meter rent 0 cents per month.
Jersey City, N. J	2.75	
Joliet, Ill	3.50	
Jacksonville, Ill	4.00	12½ p.c. off prompt pay.
Jefferson City, New Orleans, La	4.00	
Johnstown, N Y	3.50	
Knoxville, Tenn	3.00	Meter rent 15 cents.
Lyons, N. Y	4.00	
Lima, Ohio	3.80	
Lynchburgh, Va	3.00	5 p. ct. added to bills not paid in 5 days.
Lonisiana, Mo	4.50	
La Crosse, Wis	4.50	50 cents per M. off prompt pay.
Lancaster, Pa	3.00	
Louisville, Ky	2.70	5 p. c. off prompt pay.
La Porte, Ind	3.50	Wood aud oil gas.
Lowell, Mass	2.50	25 cents per 1000 off prompt pay.
Lafayette, Ind	2.75	
Lexington, Mass	2-40	Wren's process.
Los Angelos, Cal	6.00	
Lockport, N Y	3.20	Less 20 p c per M. if paid within 30 days.
Millville, N. J	3.12	
Milford, Del	3-50	
Marquette, Mich	3.50	
Morris, Ill	2.00	For 15 candle power, or $10 per M. coal gas meter measure (Petroleum Gas—Wren's patent).
Meriden, Conn	3.93	
Marietta, Ohio	3.50	20 cts. per M. off if paid by 6th. Consumers over 3000 ft. 30 cts. additional discount.
Marshalltown, Iowa	4.50	50 cts p M. off prompt pay.
Meadville, Pa	3.50	25 cts p M. off prompt pay.
" "	2.50	For over 10,000 ft. per month,
Madison, Ind	3.75	25 p c off if paid in five days: 25 to 40 cents per month meter rent.
Monroe, Mich	3.50	5 per ct off prompt pay
Malone, N. Y	4.50	
Middletown, Conn	3.56	Net.
Mount Sterling, Ky	4.50	
Monongahela, Pa	2.75	Under 5000 feet m'th $2.75 per M.; over 5000 feet per month $2.50 per M.
Minneapolis, Minn	5.00	10 p c off prompt pay.
Mahanoy City, Pa	10.00	70 candle; 20 p c off prompt pay. Patton's process
Morristown, Pa	3.00	18 candle coal, an
New York, New York	2.50	
" " Harlem	2.75	
" " Manhattan	2.50	
" " Mutual	2.50	
" " Mropolitan	2.50	
" " Municipal	2.50	Water Gas.
Nashville, Tenn	2.85	
Newark, Citizens, N.J.	2.85	
Norfolk, Va	3,10	
New Brunswick, N. J.	2.70	
Newton, N. J	4.00	
North Attleboro, Mass.	3.50	
New Britain, Conn	3.70	
New Haven, Conn	2.75	
Nantucket, Mass	3.00	Meter rent 15 cts. p. m.
Newark, N. J	2.85	
Niagara Falls, N. Y	3.50	20 cts p M. off prompt pay.
Norwalk, Conn	4.00	12½ p ct off prompt pay.
New Albany, Ind	3.00	
New City, Montreal	2.50	Street lamps, $22 p a
Oswego N. Y	3.15	5 p. c. off prompt pay.
Ottawa,, Ill	4.00	12½ p. c. off promptpay
Omaha, Nebraska	5.00	
P'keepsie, Citizens	2.70	Gwynne Harris process
Paterson, N. J	3.80	10 p. c. off prompt pay, and in addition 5 p.c. on bills of $200; 10 p. c. on bills of $1000
Portchester, N. Y	3.50	
Pittsfield, Mass	3.50	5 p. c. off prompt pay, and 10 p. c. off on bills of $350 per an
Portland, Me	3.00	
Paris, Ky	4.50	Meter rent 25 cts. p m.
Portsmouth, N. H	3.22	
Pittsburgh, Pa	1.00	
Philadelphia, Pa	2.15	
Painesville, Ohio	3.50	
Pawtucket, R. I	2.80	5 p c allowed on bills of $500, and 10 p c on bills of $1500 for six months.
Providence, R. I	2.25	
Pottsville, Pa	3.50	10 p ct off promp pay, 5 p ct off for less than 5000 a month. 10 per cent more than 5000 a month.
Plainfield, N. J	3.50	
Peoria, Ill	3.50	
Paducah, Ky	4.00	10 p c off prompt pay.
Plymouth, Pa	10.00	70 candle Patton's process.
Pottstown, Pa	3.20	Public lamps till 11 P. M., 18 nights per month $20 per lamp.
Poughkeepsie, N Y	2.60	10 p c off prompt pay
Port Huron, Mich	3.5Q	
Quincy, Citizens, Mass.	5.00	
Quincy, Ill	3.50	
Quebec, Ont	2.40	
Rome, N. Y	3.60	
Rochester, N. Y	3.00	
" Citixens	3.00	
Rondout, N Y	3.60	
Rockford, Ill	4.00	5 p c off prompt pay; 10 to 25 p c off on bills for 500 to 25 M feet per month.
Rockford, Ill	3.50	For monthly bills under 1000.
" "	3.00	For ditto over 1000.
Richmond, Ind	3.00	50 cents added if not paid by 20th.
Syracuse, N. Y	2.75	
Springfield, Ill	3.25	$25 for city lamps.
St. Joseph, Mo	4.00	12½ p. ct. off on bills over $100 p. month.
St. Albans, Vt	5.00	10 p. c. off prompt pay, and in addition 5 p. c. off bills from $50 to $100 per month; 10 per. ct. off bills over $100.
Sandusky, Ohio	3.00	
Saratoga, N. Y	5.00	20 p. c. off prompt pay, Nov. 1st to May 1st. 10 p. c. rest of year.
San Antonio, Texas	7.00	10 per ct off from 10 to 20,000 per month 20 p ct off from 20,000 and upwards.
St. Charles, Mo	4.50	
Sidney, Ohio	3.25	
Steubenville, Ohio	2.50	
Sherman, Texas	5.00	5, 10, 15 and 20 p. c. off, according to quantity.
Salem, Oregon	7.00	October last reduced from $8.
Salem, Ohio	2.75	Meter rent 12½ cts if 300 feet is not used monthly
Sedalia, Mo	3.50	
Sharon, Pa	3,15	5 per ct off on less than 5000 feet per month. 10 p ct from 5 to 15 M. 15 p ct from 15 to 20 M. 20 per ct over 40 M.
Shreveport, La	5.00	
Shelbyville, Ind	2.00	Wren's process; $10 for 80 candle gas.
Shenandoah, Pa	10.00	70 candle. Patton's process.
Shamokin. Pa	10.00	70 candle. Patton s process.
Sunbury, Pa	10.00	70 candle. Patton's process.
Stockton, Cal	4;50	
Stamford, Conn	3.50	5 p c off on 15,000 per month; 10 p c off on 25,000 p month; 15 p c off on 35,000 per month. Meter rent 12½ cts and upwerds.
Tiffin, Ohio	3.00	
Titusville, Pa	3.00	
Tidioute, Pa	2.00	Wren's process.
Vicksburgh, Miss	4.50	
Wilkesbarre, Pa	3.50	10 p. c. off prompt pay.
Worcester, Mass	3.00	5 p. c. off on $500, and 10 p. c. off on $1000 in six months.
Westfield, N. Y	4.00	10 p. c. off prompt pay.
Washington, D. C	2.25	
Watertown, N. Y	4.50	10 p. c. off prompt pay.
Wheeling, West Va	2.25	10 p ct off prompt pay.
Washington, Pa	2.50	
Woburn, Mass	3.00	
Waterbury, Conn	3.50	5 p c off on bills of $50 10 p c off on bills of $100. 5 p c added if not paid by 10th.
York, Pa	3.00	Meter rent 12½ cents.
Youngstown, Ohio	2.50	10 p. c. off on bills of $50 per month.
Youngstown, Ohio	2.50	For monthly bills under 3000.
" "	2.25	From 3000 to 5000.
" "	2.00	From 5000.
Yonkers, N Y	2.00	Net.
Waterbury, Conn	3.00	5 p c off on bills of $50, 10 p c off on bills of $100; 10 p c added if not paid by 10th.
Washington, C H., O.	1.20	Wren's process; $6 for 80 candle gas.
Wilmington, Del	2.50	Street lamps 3,650 hrs per year, $31.50 per lamp.
Zanesville, Ohio	2.70	10 p. c. off on bills o $25 per month; city lamps $23.

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,
24 Pine Street, New York City.
October 16, 1876.

☞ All communications will receive particular attention

Gas. Co.s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Harlem	$1,850,000	50	100	106
Manhattan	4,000,600	50	235	240
Metropolitan	2,500,000	100	145	150
" Scrip	$1,000,000	...	102	—
" Bonds	500,000	1000	104	—
Mutual	5,000,000	100	110	111x
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	135	140
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	10	...
Bonds	30,000		90	
Laclede, St Louis Mo	1,200,000	100	100	110
Peoples, Jersey City		...	125	135
Peoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	99	100
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	97	100
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri	600,000	50	—	100
Stillwater, Minn	50,000	50	—	26
Suburban, W'stch'str	390,000	50	—	100
Saugerties, N. Y	15,000	100	110	115
Troy, Citizens	600,000	100	—	100
Central, Westchester	466,000	50	95	100

Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	180	185
Citizens	1,200,000	20	90	95
" Scrip	320,000	1000	95	100
Peoples	1,000,009	10	45	50
" Bonds	$ 325,000	...	...	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	70	75
Nassau	1,000,000	25	75	80
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	130	135
" Scrip		...	98	100
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	--	90
Baltimore, Md	2,000,000	100	150	170
" Ctfs., gold	1,000,000		105	—
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	95	100
" " Ctfs.	53,000	—	—	—
" " Bds.	124,000	—	—	--
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind		100	...	—
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	152	—
Hempstead, L	25,000	100	...	—
Jersey City	386,000	20	160	—

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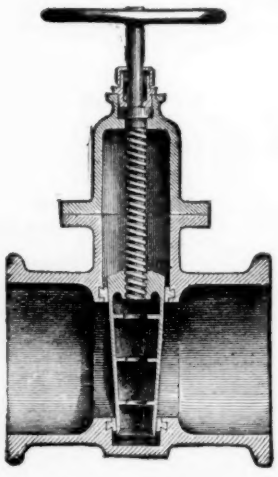

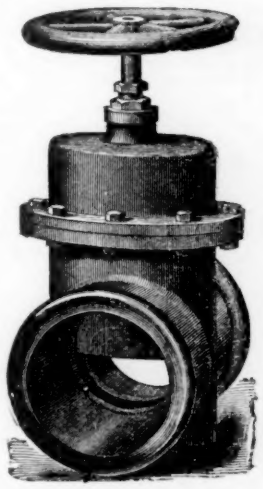

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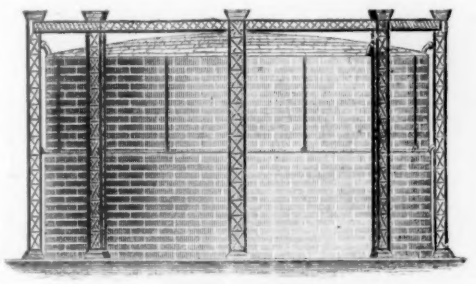

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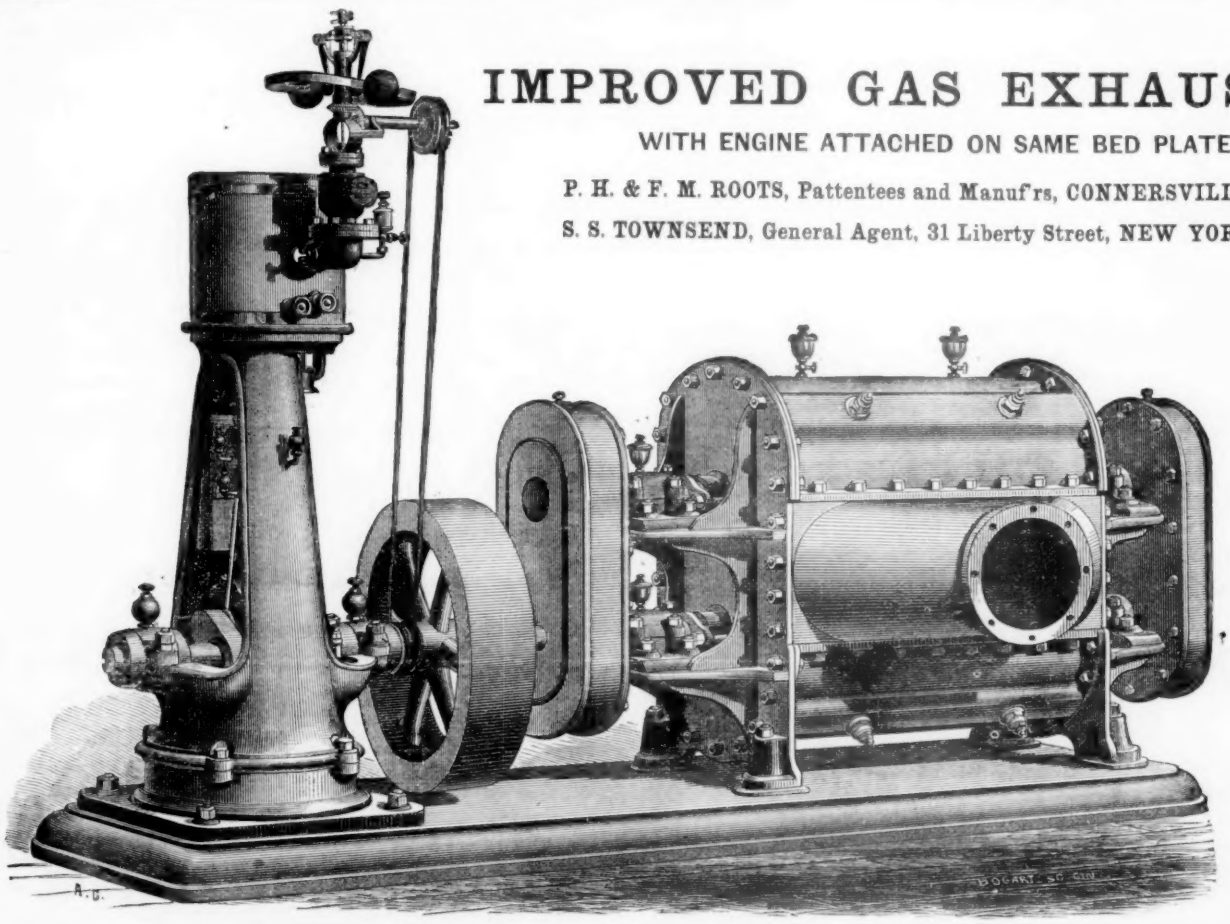

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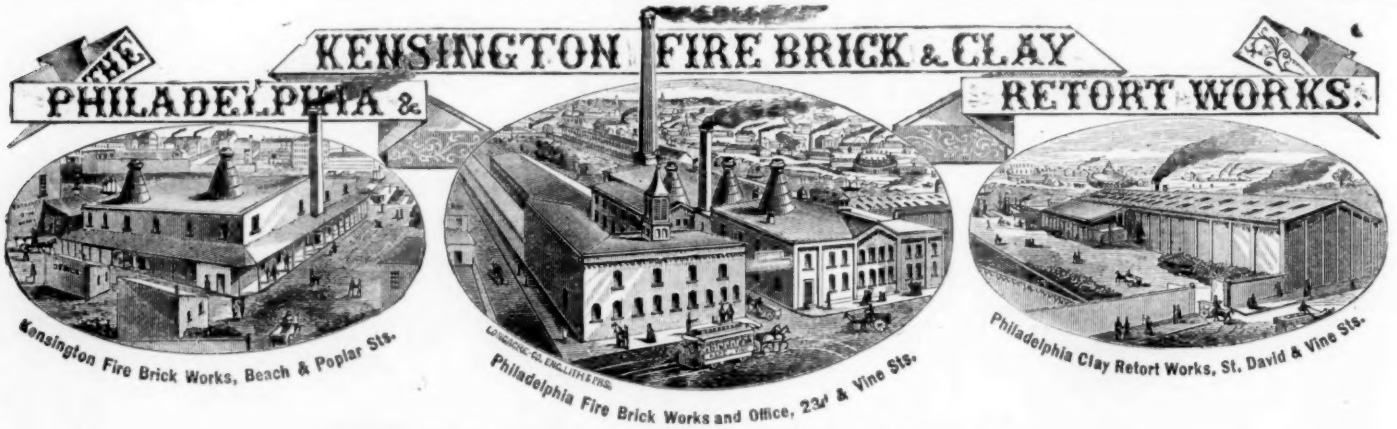
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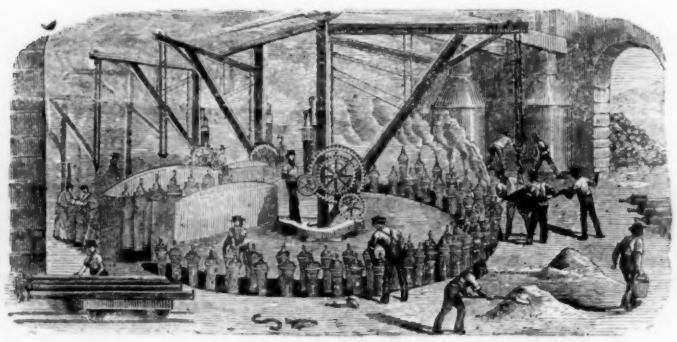

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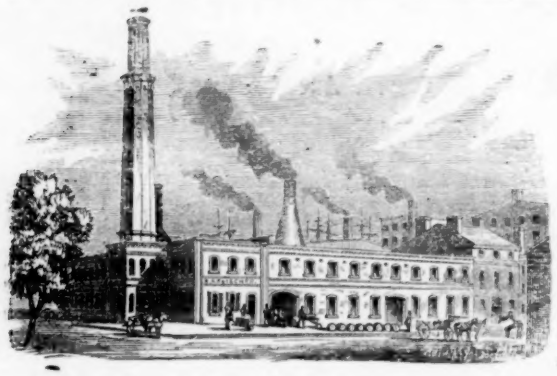

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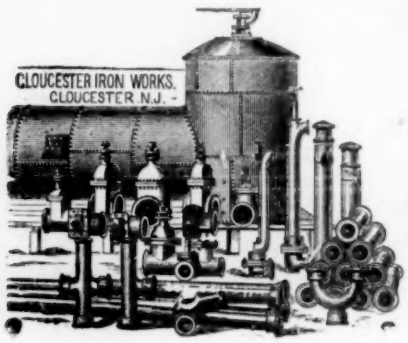

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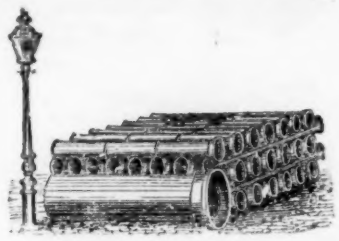

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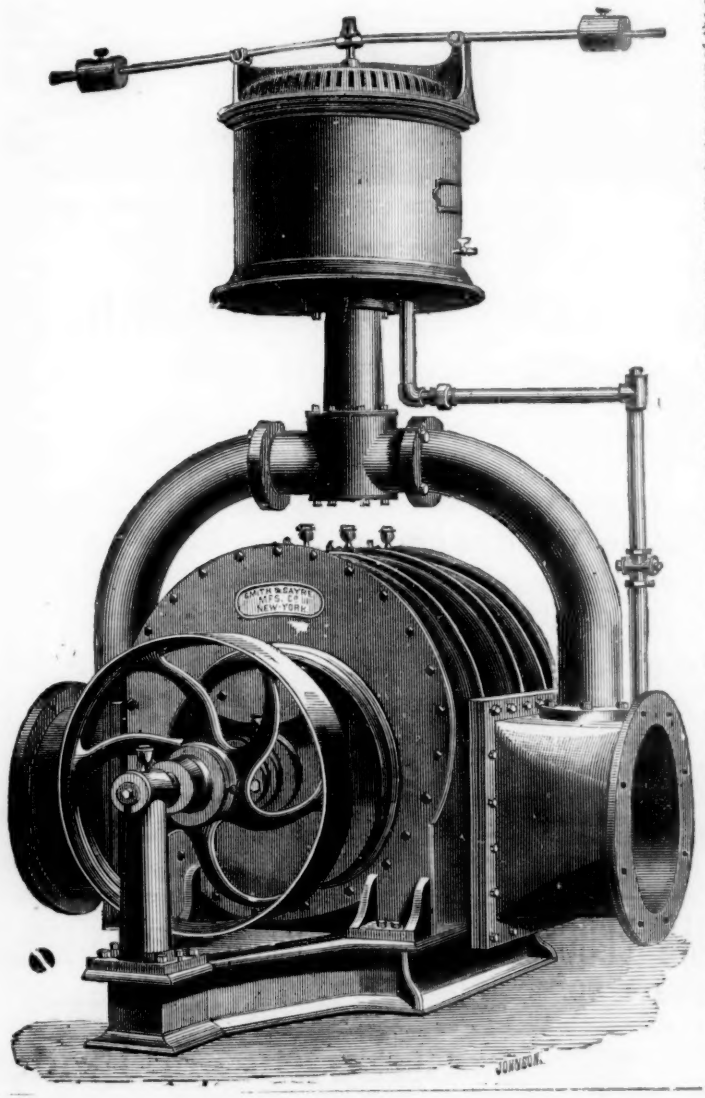

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are prepared to treat with Gas Companies and Manufacturers of Gas for the use of said processes.

An examination of the merits of these inventions as demonstrated by practical experience in a large number of Gas Works employing them, will not fail to convince the intelligent Gas Manufacturer of the great advantages derived from their use.

Gas of unexceptional quality, of high illuminating power is made at many of these works by these processes, at a cost of from 40 per cent. to 60 per cent. less than an ordinary quality of illuminating gas can be made by any other methods in use. Gas Companies generally may easily, and at small outlay for making the necessary changes in manufacturing apparatus, double their net earnings, and supply a much better light to their patrons, at greatly reduced prices.

The Company respectfully refer to Companies using these processes in this city, Reading, Penn., Chicago and elsewhere, and especially to the Mutual Gas-Light Company of Detroit, Mich., whose works more nearly conform in all details of construction to the original plans of the inventors than those of other Companies.

For Correspondence, etc., address to office as above.

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SINGLE AND TELESCOPIC—WITH CAST OR WROUGHT IRON GUIDE FRAMES.

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Steubenville, O.
Zanesville, O.
Mansfield, O.
Marion, O.
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Athens, O.
Barnesville, O.
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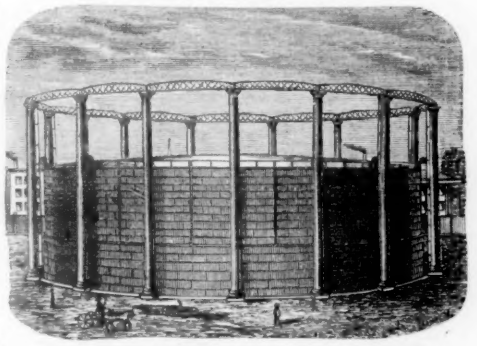

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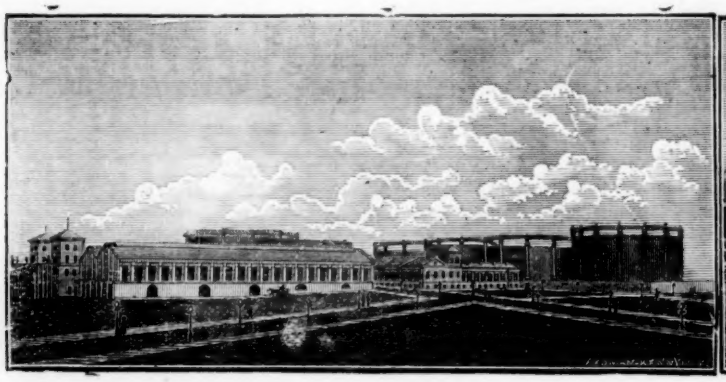

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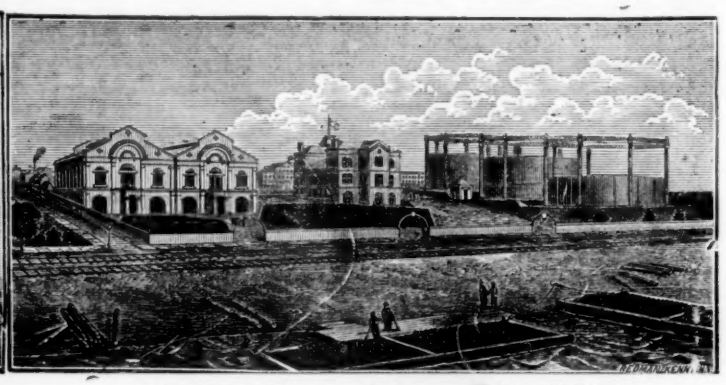

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REFERENCES:

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A. W. BENSON, President Brooklyn Gas-Light Company, Brooklyn, N. Y.
W. W. SCARBOROUGH, President Cincinnati Gas-Light Company, Cincinnati, Ohio.
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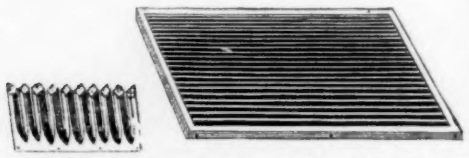

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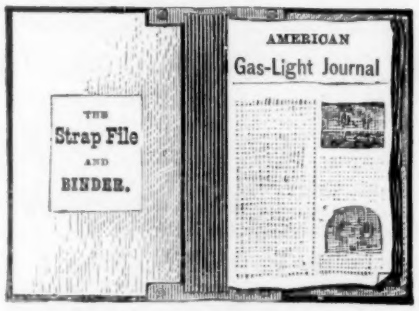

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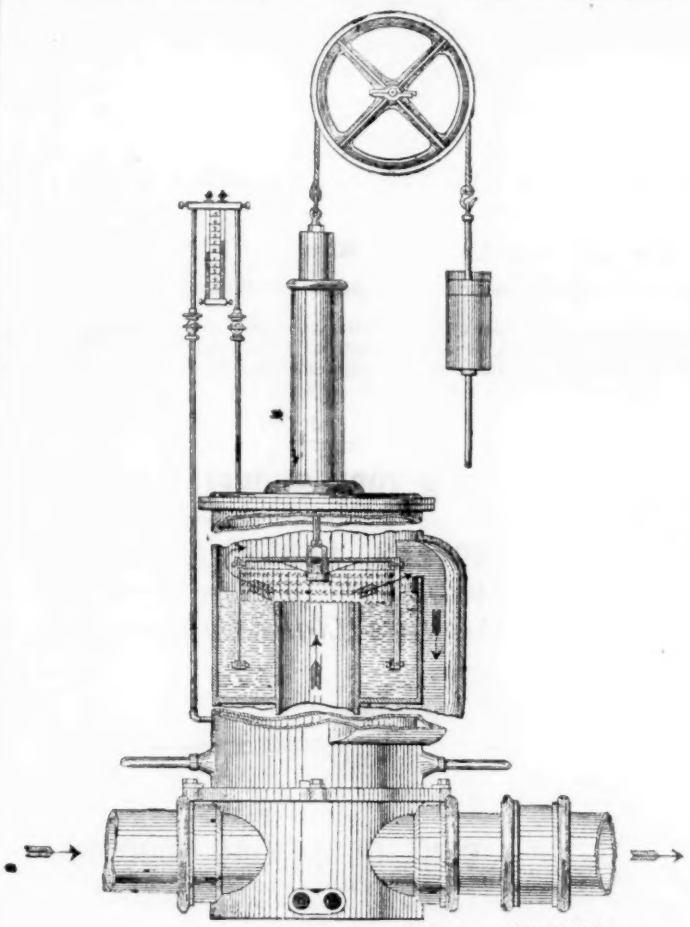

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With SMEDBERG'S COMBINED BYE-PASS, REVERS FLOW, and DIFFERENTIAL GAUGE.

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This apparatus is based upon the recent discovery by Messrs. PELOUZE & AUDOUIN of the principle of Condensation by impact, or percussion.

All gas-makers are aware how difficult it is to separate all the Coal Tar and Water from Crude Coal Gas by mere cooling; and how frequently these liquids are swept on to the purifiers, even where scrubbers or washers of large size and considerable cost are employed.

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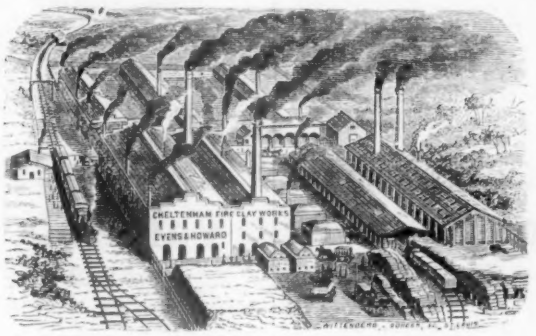

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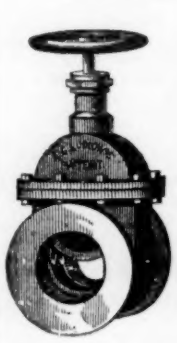

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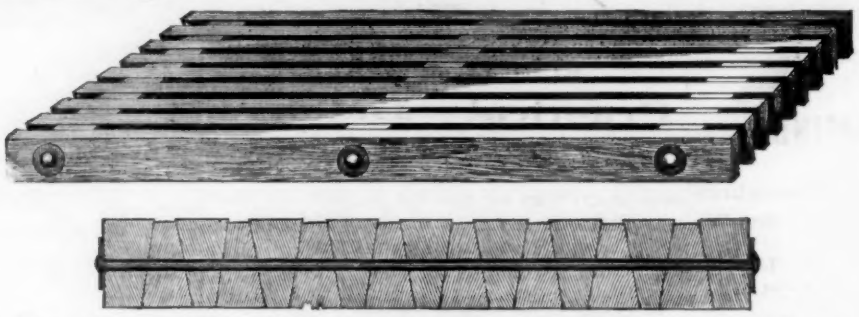

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